the OIL AND GAS JOURNAL

PUBLISHED WEEKLY OCTOBER 10, 1960

World's First Major LPG Pipeline. . .

Mid-America's 2,200-mile project to cost $67 million p.123

FPC'S NEW POLICY

- Producers are hopeful, but skeptical
- Procedure? It will have to evolve
- Restraints on FPC staff are planned
- Legislation? Needed but not likely now

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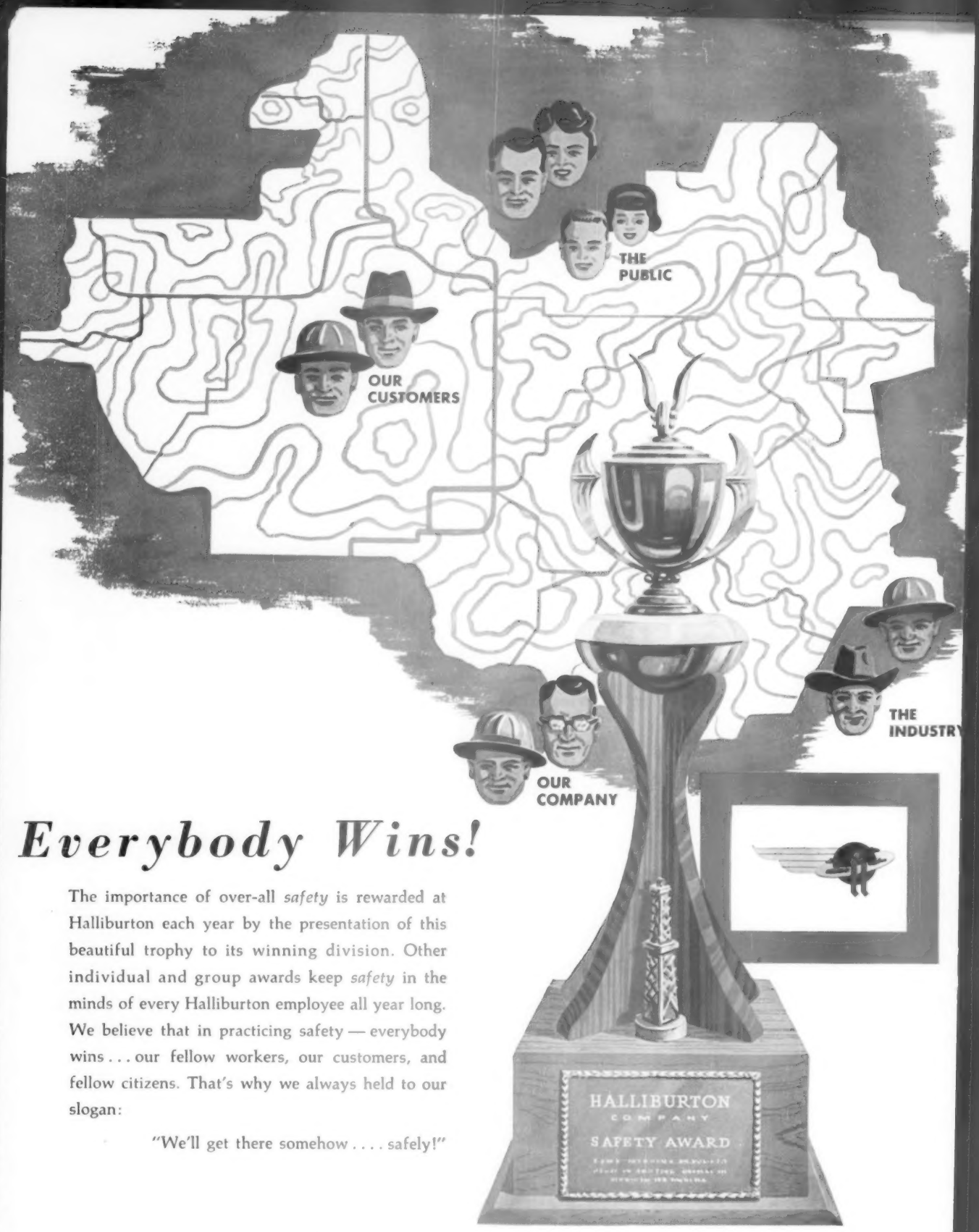
Those new cars . . .

Refiners will get no rest next year ▸ 106

How Good Are Pipeline Control Systems? p.164



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"We'll get there somehow . . . . safely!"

Halliburton COMPANY

DUNCAN, OKLAHOMA

OIL AND GAS JOURNAL
Vol. 58, No. 41

Contents October 10, 1960

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ANNUAL PIPELINE NUMBER

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the OIL AND GAS JOURNAL Newsletter

Tulsa, Okla.
Oct. 10, 1960

New cars won't take octane pressure off refiners:

Need will be as strong—if not stronger—for high-octane regular and superpremium, in spite of the economy trend and dip in compression-ratio plateau (p. 106).*

Explanation for the paradox: Older cars hitting the scrap heap are low-requirement cars. This leaves an increased percentage designed for top regular octanes.

The more powerful cars, although losing part of their share of the market, still are high-compression, high horsepower jobs. The ultra-hot cars also show no signs of fading.

Other innovations: More powerful compacts, greaseless chassis, longer lube-oil change intervals and smaller crankcases, better mufflers, aluminum engines.

▼ ▼ ▼

In the wake of FPC gas-policy decision, we find:

...Gas producers hopeful but skeptical area pricing policy will give them much relief.

...Gas industry agreed on need for legislation to free producers from control, but little chance is seen for any early congressional action.

...FPC is feeling its way into a new field and will be slow in putting area-pricing into effect (p. 101).

▼ ▼ ▼

New evidence on what happens underground when a well is fractured was presented last week to petroleum engineers meeting in Denver.

Cores taken at several points around a fractured well in Texas gave this data: The fracture was horizontal... It extended at least as far as predicted...It was not uniform in direction or thickness...Fracturing sand is not changed much during fracture job (p. 118).

Biggest LACT unit in the oil patch is claim being made for Shell's Taylor lease setup in Ventura Avenue field near Los Angeles.

Just as important: The unit paid for itself the day it

---

*Refers to article in this issue giving more details. When no page is given, the item is a Newsletter exclusive.

went into operation by eliminating need for keeping $41,000 worth of crude in storage on the lease.

The system handles 22,000 bbl, of crude daily from more than 500 wells. It has a capacity of 36,000 bbl. daily which was built in as stand-by capacity (p. 109).

▼ ▼ ▼

Africa is slowly emerging as a major new source of oil. Sensational strikes within the last 18 months have left a string of fields from Gabon into Libya and kindled interest in the continent.

Besides basins in the northern interior which contain thick marine sediments, future oil targets undoubtedly will be the extensive embayments lying all around the continent (p. 286).

A reworked oil discovery of 1958 has turned into a big gasser in the Oklahoma Panhandle.

The well is Cities Service 1-A Murdock in Texas County. Production is from Morrow L sand at 6,016-96 ft. Flow was 110,000 M.c.f. daily.

As an oil well 2 years ago, the Murdock flowed 203 bbl. daily on completion at 6,380-98 ft. in Morrow sand.

▼ ▼ ▼

Significant step toward gasification of American lignite has been made by Bureau of Mines at Grand Forks research lab. It opens possibility of lignite as a future source for chemicals and as a substitute for natural gas.

Tests were run in a new pressure gasifier. It is a fixed-bed type and operates on char, a partly carbonized lignite. Steam and oxygen react with the char to make product gas of good quality at high over-all efficiencies.

A pneumatic computer which can perform as complicated functions as one made of electronic elements is in sight.

Developed by Army Ordnance personnel, component pneumatic units which can perform amplification, feedback, digital and analog computations, mathematical functions, and memory already have been built. Such a computer would function slower than high-speed electronic ones.

First applications probably will be in military control systems, but industrial applications also are being investigated.

Domestic motor-fuel use this year will be 3.5% above last year, the U. S. Bureau of Public Roads predicts.

Its estimates for 1960:

63.8 billion gallons of all motor fuels including 55.8 billion gallons of gasoline, 2.5 billion gallons of special fuels such as diesel and butane, and 5.5 billion

gallons for non-highway use.

State-by-state gains range from 0.8% in West Virginia to 8.1% in Arizona and 8% in Hawaii (p. 115).

▼ ▼ ▼

IPAA is renewing its plea for a cut in oil imports. In a letter to Interior Secretary Seaton, IPAA said current data further bear out the need for action it sought last May.

IPAA's main point: Crude production in the first 6 months of 1960 was less than the average for 1957—the base year for the import-control program.

India will attend the Arab Oil Congress in Beirut this month as an observer. Only two other non-Arab countries—Venezuela and Italy—have received similar invitations.

India generated some resentment in the Middle East when it forced down import prices immediately before the recent break in posted prices.

▼ ▼ ▼

On the labor front:

Operating engineers and construction laborers unions have called off a strike at California Oil Co.'s 123,000-bbl. daily Perth Amboy, N. J., refinery. Instead they voted to accept revised company offer giving minor wage adjustments in two job classifications, better distribution of vacations, and other benefits.

Baytown Employes Federation has filed petition for collective bargaining election at Humble refinery. It's first move to oust OCAW which won the rights in voting last year.

The Humble-Monterey merger negotiations do not include Monterey's 15.8% ownership of Transwestern Pipeline, the new gas carrier running from Texas to California.

Many oil men considered Monterey's share of the line one of the principal factors in the talks. But apparently the big Jersey Standard subsidiary wants no part of the interstate gas pipeline business.

Monterey, Warren Petroleum, and Butch Butler, Houston pipeline contractor, are principal owners of Transwestern. Without the pipeline interest, Monterey still has two big assets: Daily production of 15,000 bbl. (about half of it in California) and a growing stake in California's offshore play.

Pipeline jobs: Eight contractors won awards to build sections of the 1,400-mile system bringing Alberta gas into the San Francisco area (p. 116)...The 22-mile, 8-in. Kenai pipeline from Swanson River field to Nikiski in Alaska is now moving crude (p. 114).

Market Memo

Oct. 10, 1960

Refiners are living dangerously these days.

Their market is a paradox—on the one hand, crude is tight and scarce at posted prices; on the other hand, products are excessive, and posted prices are nervous.

Both buyers and sellers in the market are cautious in this cloudy atmosphere. Interrefinery buying, which earlier strengthened posted prices, apparently has left the major companies "bought up" for the time being.

Gasoline demand has been disappointing, and light-fuel demand must develop before prices are tested. Firm crude prices and probable higher labor costs are deterrents to lower product prices.

Excess inventories of light products, however, are exerting pressure on posted prices.

Gulf Coast markets are listless due to lack of demand.

Prices are steady at posted 11.25 cents per gallon for 92-RON gasoline and 8.25 cents for No. 2.

Independent refiners probably have four T-2's of gasoline for sale at current posted prices for prompt delivery from the Gulf Coast. The majors hold eight to ten cargoes.

One T-2 quantity of high-octane gasoline was reportedly sold by a major last week for West Coast delivery at the equivalent of one-half cent under posted price.

River markets also are inactive. Gasoline inventories are building up, and refiners asking prices are not closing any spot deals.

Rumors of 11 cents for 92-RON out of the Helena-Memphis area indicate the price is slipping.

Spot seasonal demand for middle distillates is slow and inquiries are few. No. 2 generally is being held for one-quarter to three-eighths cent over Gulf Coast low.

The Chicago gasoline market is holding at posted level of 12.625 cents for 92-RON.

Posted prices on No. 1 of 10.25 cents and No. 2 at 9.50 cents are being closely watched for change. Whether the price trend is up or down remains to be seen. If recent discounts continue in the face of slack demand, present posted prices in Chicago will be in jeopardy.

Great Lakes pipeline gasoline is generally reported firm at posted price of 12.50 cents for 91-RON. However, discounts of one-quarter to one-half cent continue.

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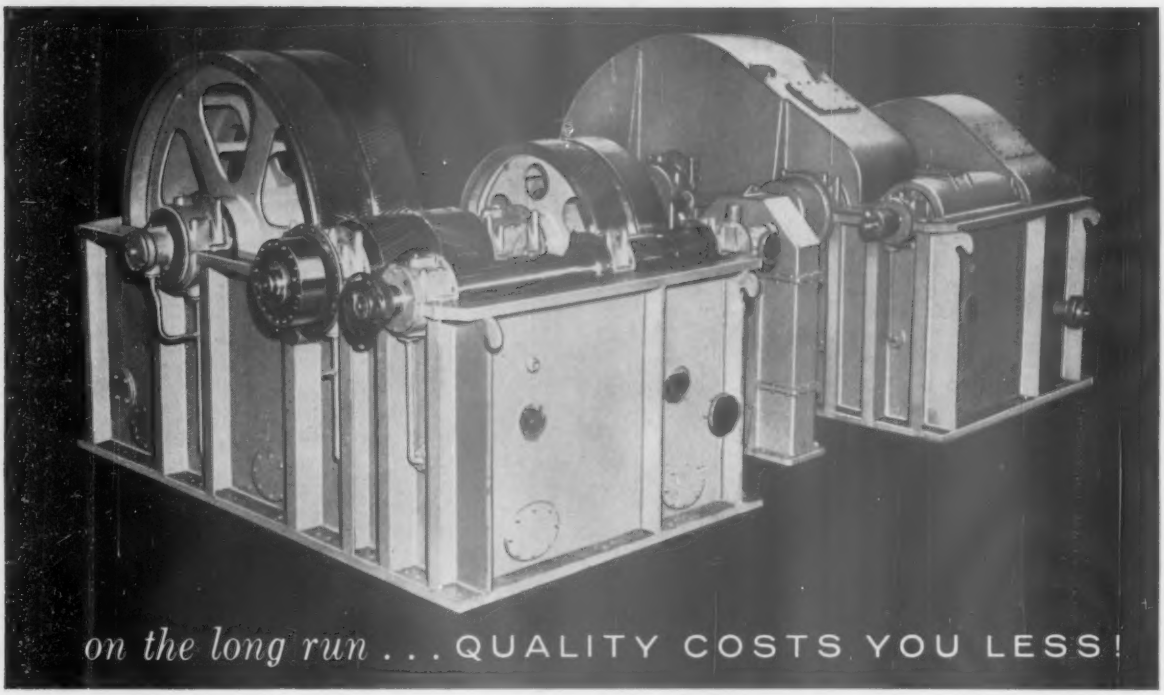

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EFFICIENCY — Western Gear high precision manufacture guarantees low power losses through the gear drive ... a vitally important factor in the high proven efficiency of engine driven pipeline centrifugal compressors. Certified factory full-load, full-speed tests show a maximum of 2.0% loss through the 5,000 horsepower 2-stage drives pictured. Truly exceptional, considering the unit size and relatively high speeds encountered ... over 6,000 r.p.m. and 15,000 f.p.m. pitch line velocity.

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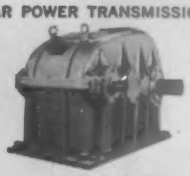
WG-6003

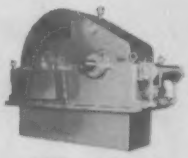
Photo above shows one of twenty units installed over three years ago on Columbia-Gulf Pipeline (formerly Gulf-Interstate Pipeline). Units are of the 2-stage type similar to the ten units currently being supplied for Transwestern. Cooper-Bessemer natural gas engines capable of delivering 5,000 horsepower at 360 r.p.m. drive through Western Gear Corporation Model 4525THS20-16 pipeline drives to Cooper-Bessemer centrifugal compressors at 6,050 r.p.m.

OTHER WESTERN GEAR POWER TRANSMISSION PRODUCTS

integral gearmotor


parallel shaft reducer

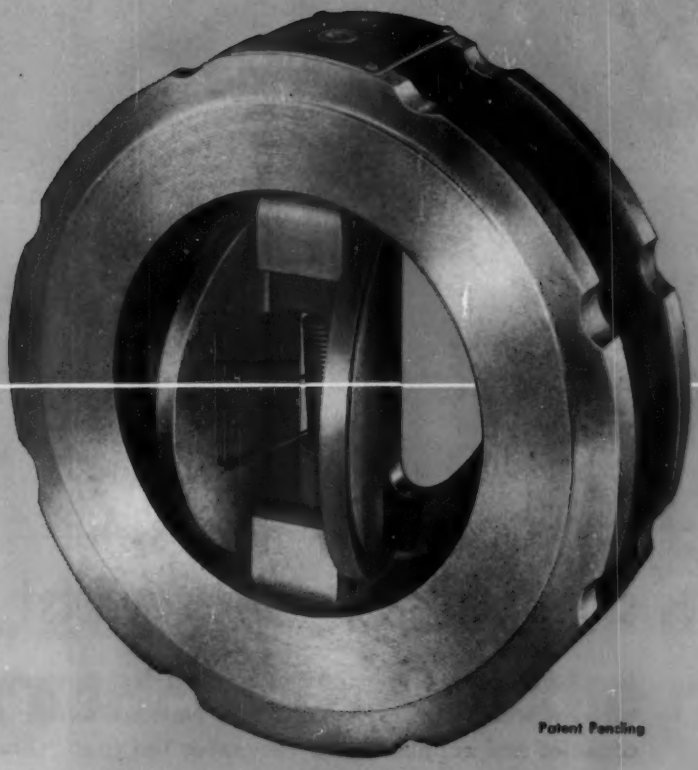
vertical shaft reducer


high speed unit

right angle reducer

fits between the flanges

less space—weighs only 10% as much



Patent Pending

Mission Duo-Chek valves

Mission Duo-Chek Valves weigh approximately 10 per cent as much as conventional check valves. Smaller, lighter Duo-Chek Valves mean that you save on space, weight, installation, and price. But, you are getting a check valve with a bubble-tight seal, anti-slam closure, long life built in. No load is carried on the plate hinges. No external parts. No lubrication required.

The sine wave seal prevents seepage, yet holds without leaking or distortion at maximum test pressure. The sealing material is molded and bonded into a metal groove, making an "O"-ring type seal. Pressure deforms the packing. Metal-to-metal contact completely encloses the sealing material, preventing pinching off under pressure. Available in steel, 316 stainless, aluminum, and bronze to fit ASA raised face or ring joint flanges.

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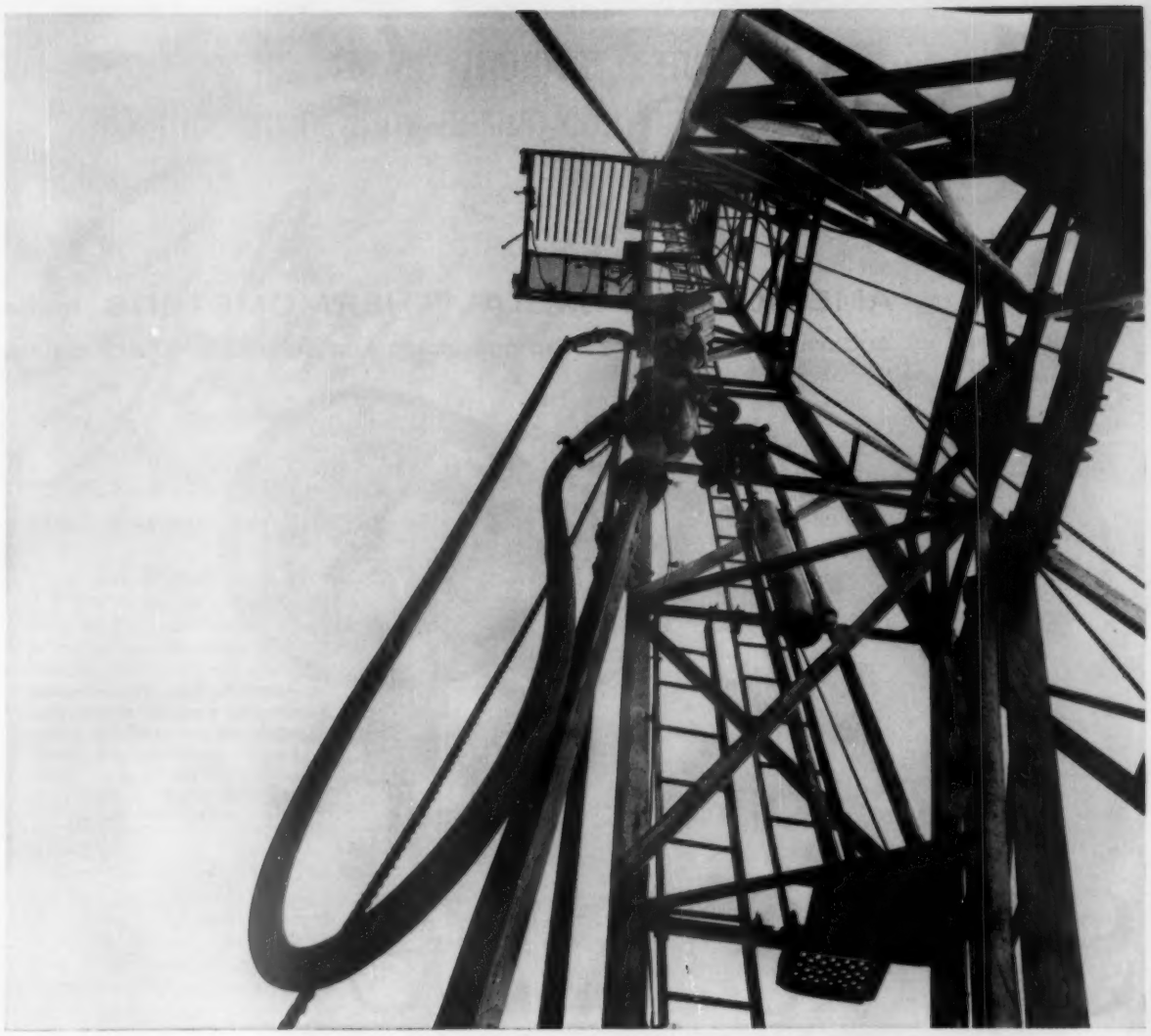

2½ years, 200,000 feet drilled with B.F.Goodrich hose on the rig

THAT B.F.Goodrich rotary drilling hose has paid for itself and has given its owner a 50% bonus in service. Previous hose used on this rig gave out after just a year. But B.F.Goodrich hose, after 2½ years in which the rig drilled a total of 200,000 feet, was still going strong. And there hadn't been a minute of downtime for hose maintenance.

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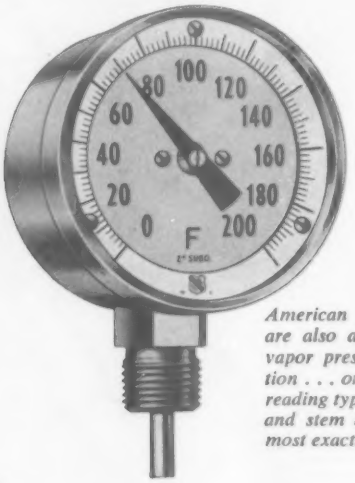

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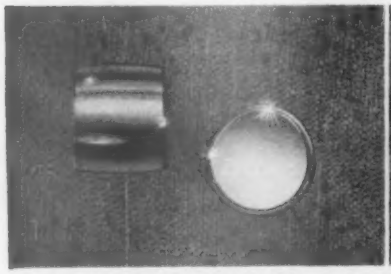
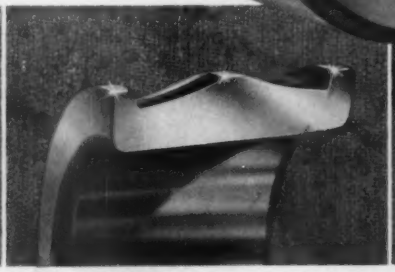
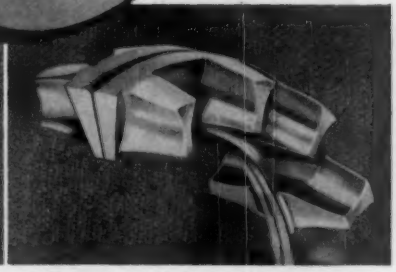


BIG, HIGHEST-CAPACITY ROLLERS. Each bearing has a maximum number of rollers —as large as possible, yet all components are in optimum balance.



HIGH, HEAVY INNER RACE FLANGES present convenient hold for assembly and removal of bearing without cutting away shaft, avoid any need to skimp on shaft shoulders.



PRECISION-MACHINED, CENTRIFUGALLY-CAST BRONZE RETAINERS have many times more support and ability to withstand high stress. They are not stampings. Design assures maximum bearing efficiency.

Zone Isolation Unmatched

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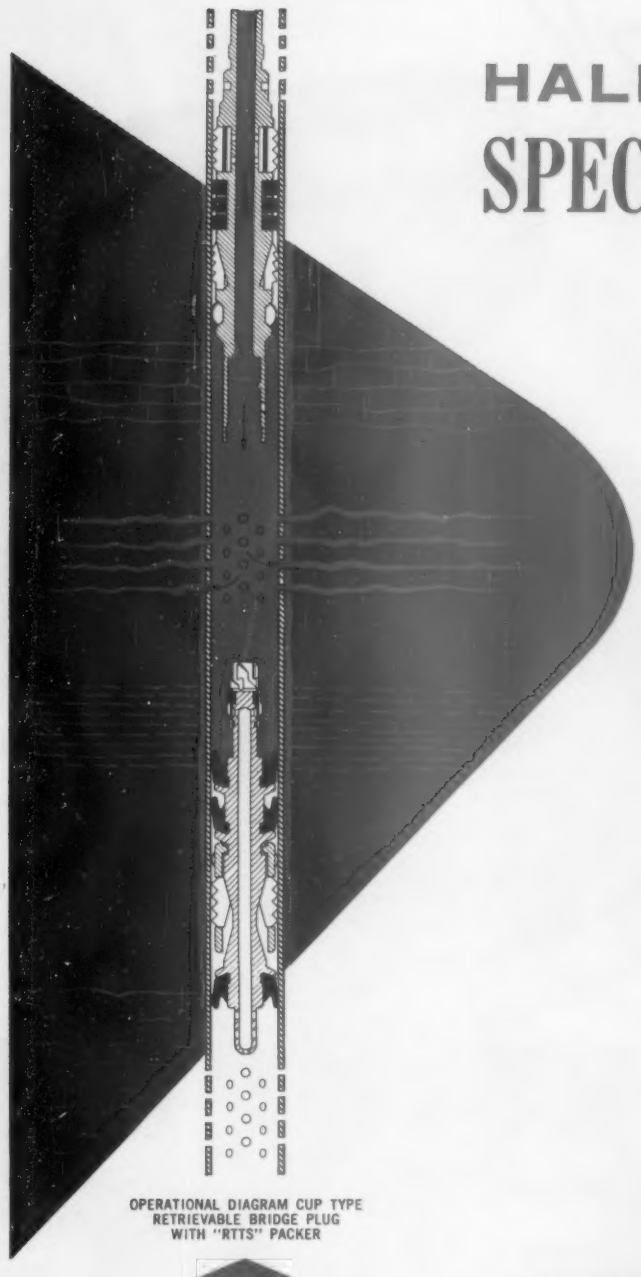


OPERATIONAL DIAGRAM CUP TYPE
RETRIEVABLE BRIDGE PLUG
WITH "RTTS" PACKER

Although flexibility in design permits the advantageous use of Halliburton Special Tools for a multitude of jobs, zone isolation for production improvement is one of their most profitable applications. This is accomplished by forcing a treating fluid into the formation to remove flow restrictions in the naturally permeable channels, or to enlarge the flow channels by chemical action or hydraulic fracturing.

Halliburton Special Tools include well-engineered packers and auxiliary tools that are run on tubing into the cased hole to isolate the zone to be treated. This procedure is designed to force the treating fluid into the designated zone, confine the high pressure to this section only, and realize the maximum production from the well's potential.

Use the unmatched performance of Halliburton Special Tools for the production improvement of your wells. A call to your nearby Halliburton office will bring full information about the Special Tools best suited for your specific requirements. Call Halliburton today!

HALLIBURTON 2-7/8" TUBING TENSION PACKER

This new retrievable packer is a valuable multi-purpose tool. Equipped with the circulating valve shown, you can perform treating or squeezing operations through this packer. Without the circulating valve, the tool may be used as a production packer. The packer is set by turning to the right and pulling upward on the macaroni tubing string on which the tool is run. Tension setting feature simplifies application of setting force . . . and there is no need for an auxiliary hold down.

HALLIBURTON CUP TYPE RETRIEVABLE BRIDGE PLUG

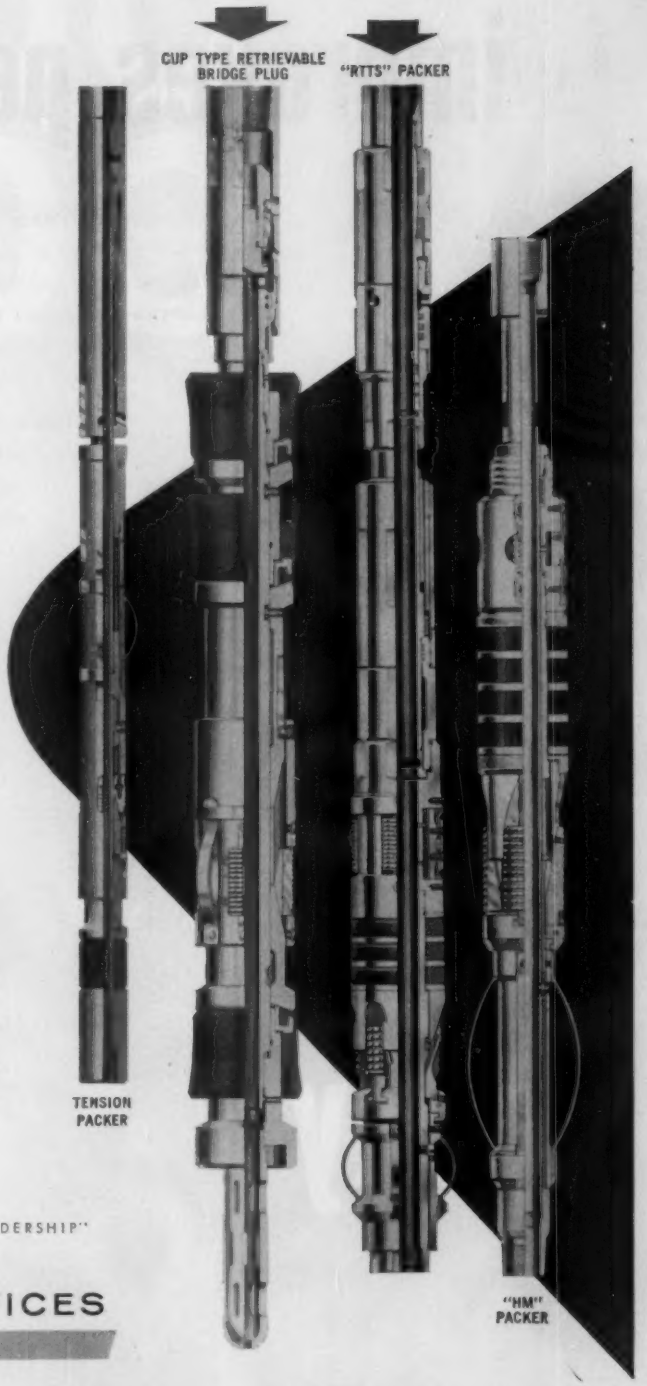
Designed to provide a positive but easily removable plug in cased hole to hold pressure from either above or below. Valuable in providing straddle packer type isolation of zones with virtually unlimited spacing between packers without restriction of flow passage. Especially adapted for running in below a retrievable tool such as the "RTTS" Packer for isolation of one or more zones. Setting and retrieving functions of the Bridge Plug are matched to the "RTTS" Packer; this combination permits "straddling" of any desirable zone, so that multiple zones can be isolated individually with only one trip in the hole.

HALLIBURTON "RTTS" PACKER

The industry's most efficient multi-purpose tool, the Retrievable Test-Treat-Squeeze Packer, is designed for testing, treating and squeezing operations. It permits combination high pressure treating and squeezing applications, as well as testing, with *only one trip into the hole*. Equipped with full-opening fluid passage . . . incorporates circulating valve and safety joint.

HALLIBURTON "HM" RETRIEVABLE PACKER

A hook wall type packer run on tubing in cased hole to provide a seal above the zone to be fractured or acidized for production improvement. Allows large volumes of fluid to be pumped through tool with minimum drop in pressure. Set by weight of tubing; released by picking up. Hydraulic slips prevent movement of packer up the hole. Can be set and reset for multiple treatments as many times as desired without coming out of the hole.



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For information on epoxy coatings, and on Humble's complete line of paints and protective coatings, call your Humble salesman or contact Humble Oil & Refining Company, Houston, Texas

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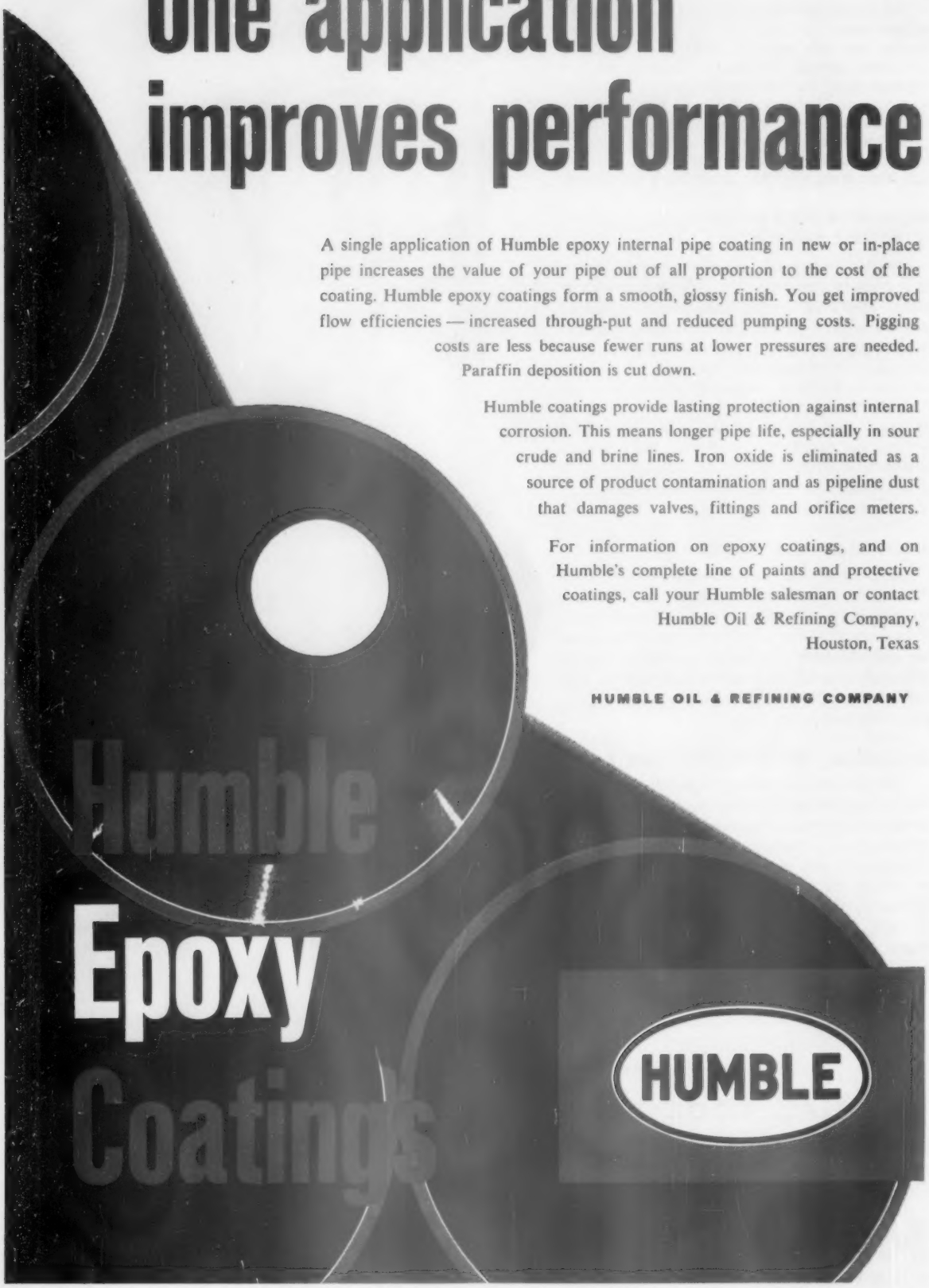

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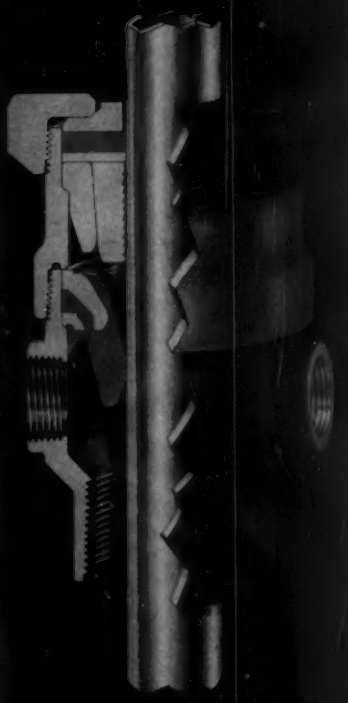
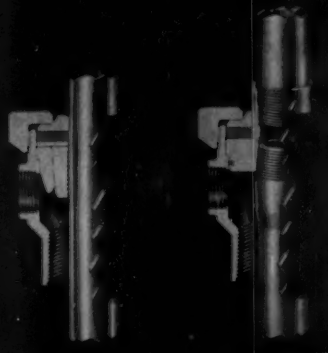


TYPE "SK" SLIP SUSPENSION WITH STRIPPER



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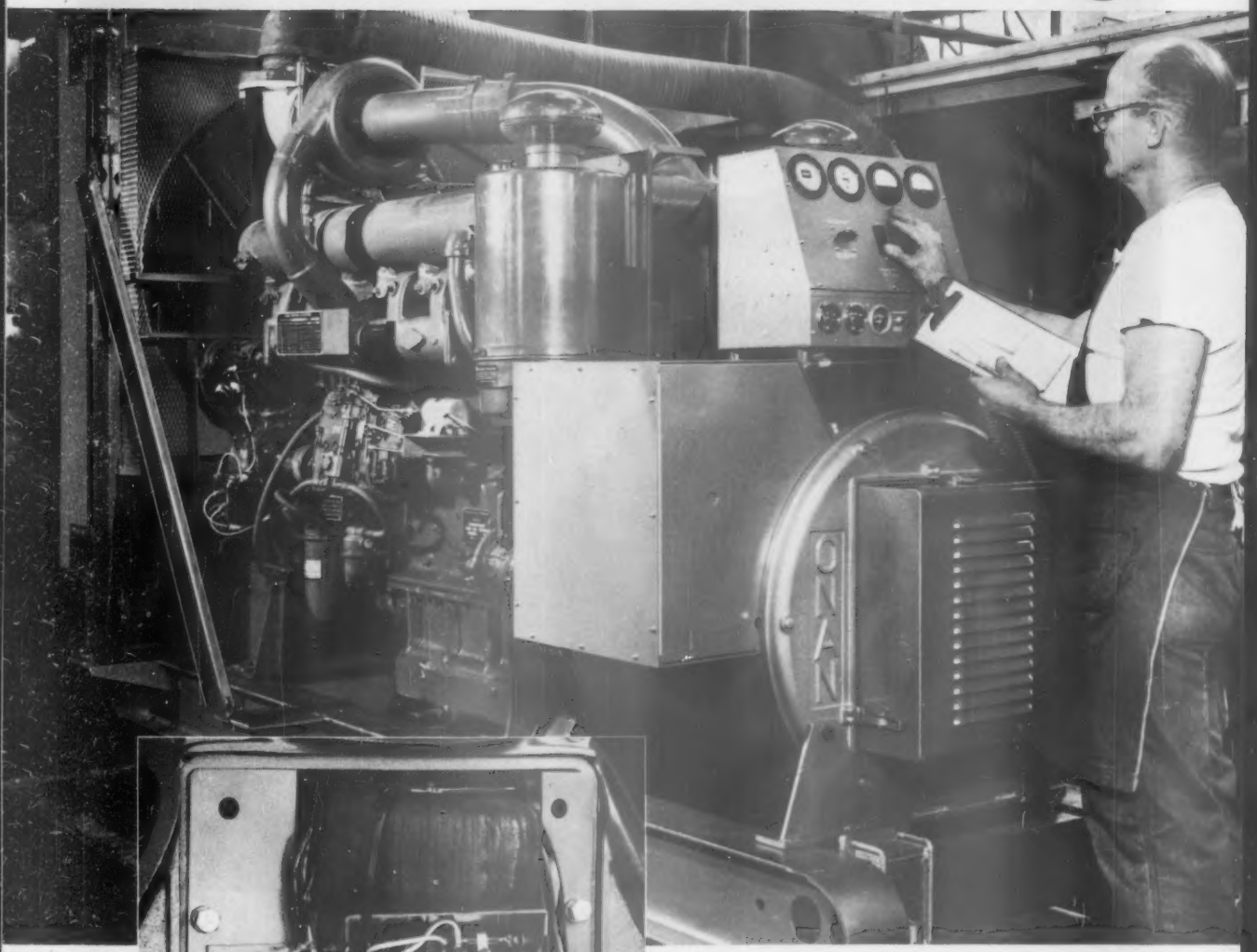
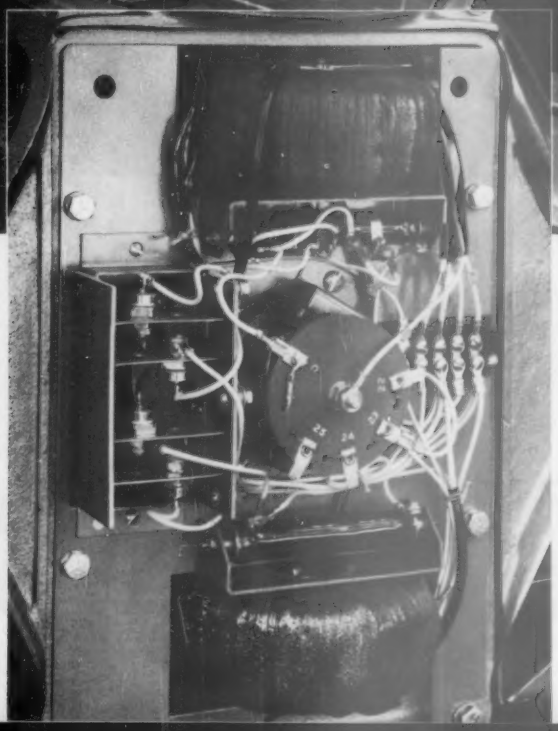
recovers voltage





Use Magneciter-equipped Onan for standby or primary power. Takes maximum starting load without hesitation! Available on all diesel and gasoline-powered Onan Electric Power Plants rated at 25 KW and up.

Static exciter and magnetic amplifier and regulator of Magneciter Generator with cover removed. No moving parts in this *static* exciter and regulator. No extra sensitive adjustments needed. Magneciter means reliability!

Onan Magneciter
within 1 second

Even when maximum starting load is applied, Onan Magneciter gives voltage recovery 5 times as fast as ordinary rotating exciter generator

When a heavy starting load causes a voltage dip, the Onan Magneciter Generator restores full voltage within one second. Old-fashioned rotating exciter generators take more than five times longer. Furthermore, Onan Magneciter has no moving parts in its exciter and voltage regulator, thus eliminating hundreds of potential causes of wear.

It's no longer necessary to buy a generator much larger than your normal power needs just to get enough extra power for the heavy drain of starting motors. Onan gives you this margin of power, builds it into every Magneciter-equipped Onan Electric Plant.

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We certify that when properly installed and operated this Onan electric plant will deliver the full power and the voltage and frequency regulation promised by its nameplate and published specifications. This plant has undergone several hours of running-in and testing under realistic load conditions, in accordance with procedures certified by an independent testing laboratory.
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CONTACTOR

SERIES 5

AMINE PROCESS DESIGN AND OPERATING INFORMATION

While ethanolamines are an excellent medium for treating gas, their satisfactory application depends on proper use of the amines and correct design of mechanical equipment. Some of these important design and operating considerations are discussed in this series.

Removing Suspended Solids in Treating Systems

Sludge that is commonly found in amine units is typically more noble than mild steel. Its deposition on steel surfaces in static or low velocity sections of amine units can result in galvanic-cell type corrosion.

In units that accumulate large volumes of sludge, the possibility of entrainment of iron sulfide and siliceous materials from the producing formations should be investigated. Proper separation equipment should be installed ahead of the amine contactor where such carry-over is occurring.

To remove suspended solids, a precoat filter of adequate cake capacity should be installed. *Rate* and *location* of filters are both important factors in the effectiveness of filter units. They should not pass particles larger than 5 microns, and rates should be such that suspended solids do not accumulate in the amine solution. The following locations are the most likely trouble spots:

1. Exit from the absorber.
2. Rich amine inlet to the hottest heat exchanger.
3. Rich amine exit from the hottest heat exchanger (inlet to the reactivator).
4. Exit from reactivator (lean amine inlet to hottest heat exchanger).
5. Lean amine exit from hottest heat exchanger.

In general, deposit of solids appears to occur to the greatest extent on the shell side of exchangers or in reactivators. Since the rich amine is usually on the shell side, locations 2 or 3 may be preferred. In general, positions 2 through 5 permit a single location of the filter with minor piping changes permitting operation on any of these streams. Initial operations should be on a stream just ahead of the point of greatest solids deposition.

Preventing Mea Losses

Properly designed ethanolamine treating plants can be operated with a minimum of chemical loss. For example, this is proved by plants operating in the range of .25 to .5-lb. of MEA/MMCF of gas processed. In such plants, much stress is given to the prevention of spill losses, pump-seal or packing leaks and solution waste. The amount of amine solution loss that can be attributed to these causes is surprising.

Entrainment represents a dead loss which can be corrected by properly designed mist extractors. MEA and DEA are known to foam under certain conditions, and for this reason can form fogs with particles in the range of 0.5 to 20 microns in size. Equipment is now available for separating particles of this size and can be employed to stop contactor carry-over. Mist extractors are not too important on the still overhead, since the carry-over is caught in the reflux accumulator.

Just as cleanliness usually indicates a well operated plant, a clean solution normally indicates low amine losses. This is a good analogy since foaming and excessive corrosion go hand in hand with dirty solutions.

Prevention of Foaming

Foaming can be a troublesome source of amine losses and reduced capacity. Some cases are: finely divided suspended solids; organic acids in the gas stream; degradation products and dissolved hydrocarbons.

Foaming due to suspended solids is best controlled as described above. Organic acids and degradation products are best removed by use of an adequate reclaimer (vacuum units should be considered for diethanolamine units).

In some cases, activated charcoal filters have been used to remove hydrocarbons and other foam producing contaminants. Foam inhibitors should be used to relieve foaming temporarily. *GE Antifoam 60* is a very effective inhibitor. *Ocenol* has also been used in many cases.

Treated Water Is Essential

Amine solution should be made up with deionized water *only*. In most cases, steam condensate is available and should be used. Introduction of foreign ions, particularly chloride, can contribute to corrosion.

FOR MORE INFORMATION, on gas treatment, look for the next Allied Chemical Contactor.

For specifications and local offices, see our insert in Chemical Materials Catalog, pages 475-482 and in Chemical Week Buyers Guide, pages 37-44.

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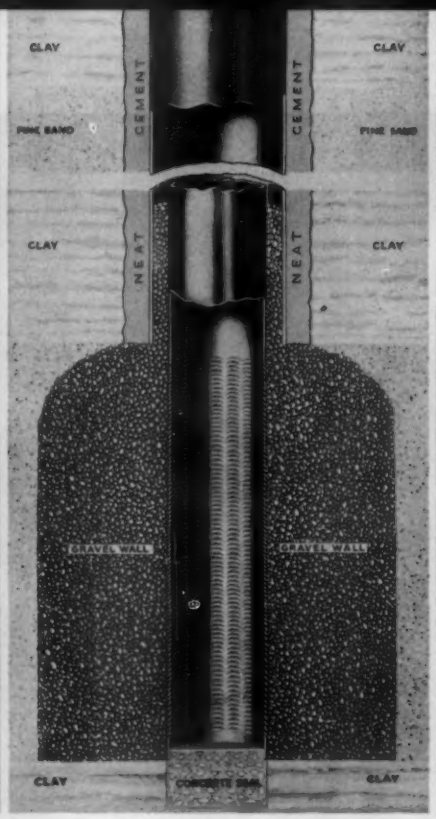

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With A Layne Gravel Wall Well This technique and resulting arrangement of the new 134 Shutter Screen and gravel (shown here) permits the free flow of water into the well and affords the following advantages: larger shutter screen openings, reduced friction, reduced draw down and pumping head—thereby reducing pumping costs, increased specific capacity and more effective retention of native sands. Cemented wells are installed if indicated, and result in greater purity of supply as well as increased life of the well. *Bulletin No. 900*

With A Layne Vertical Turbine Pump Whatever the pumping requirement, there's a Layne pump to meet any pumping conditions. Layne Vertical Turbine Pumps come in a wide range of sizes and capacities, delivering 30 to 20,000 GPM and requiring from 4 to 42 inch well casings. The complete line of Layne Pumps include: Deep Well Vertical Turbine (oil or water lubricated), Short Coupled Vertical Turbine, Propeller, Mixed Flow, Fire Pumps and Volatile Liquids Pumps, Regular and "In-Line" Submersible. *Bulletins No. 200 (oil) 201 (water)*

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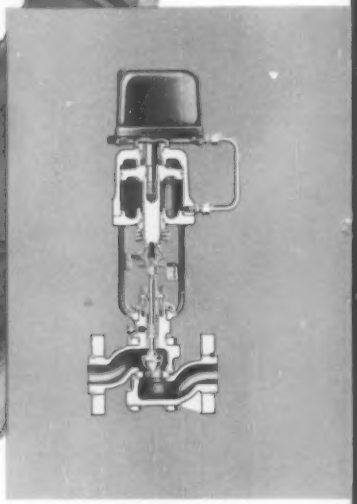


SPLIT BODY CONSTRUCTION

Type 470-Z Actuator with a Split body. P.O.P. is also ideal for three way bodies and large single port globe or angle bodies. Only Fisher gives you such a wide selection of actuator-body combinations.,

Piston Actuator for Control Valves

does jobs that once required giant size equipment!

POWER—Thrusts up to 17,500 pounds available. Delivers same power in either direction at any point of the stroke.

ACCURACY—Maximum Hysteresis 0.15% of stroke or signal. Repeatability 0.03% of stroke or signal. Resolution Sensitivity 0.02% of instrument signal.

SPEED—4 inches per second stroking speed with the Size 30. Size 60 provides 1.5 inches per second.

STABILITY—Built-in intermediate feedback causes proportional band of positioner to be broad while instrument changes are taking place, yet narrow when unit is not in motion.

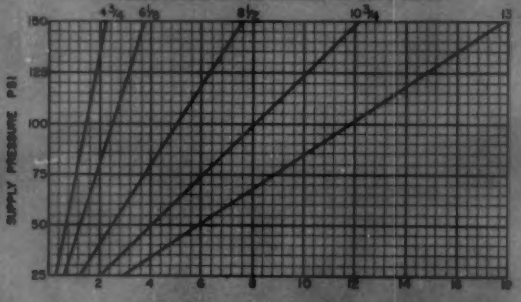
Here's power plus in a small package! This compact Fisher 470 Series has its own positioner mounted integrally on top of the cylinder. Positioner receives any of the normally used pneumatic instrument signals. Then, without an air set, actuator utilizes the full potential of the available air or gas supply (up to 150 psi) to provide exceptional speed and power.

Series 470 is adaptable to virtually all types of valve bodies including butterfly valves. Easily reversible actuator can be changed in the field. Available in six basic sizes and can be supplied for travel up to 4". Basic actuator can also be furnished with a handjack, hydraulic snubber, pneumatic safety devices or as a spring return unit . . . **Write for Bulletin E470.**

BRACKET MOUNTED SERIES 480 P.O.P.

The versatility of Fisher's P.O.P. actuators is further highlighted in the bracket mounted Series 480. The Series 480 provides a compact, powerful actuator for the operation of butterfly valves, louvers, large rheostats and similar equipment found in many industrial applications.

AVAILABLE STEM FORCE



Besides the five basic sizes shown by the curves, a 17 inch cylinder can be supplied to provide thrusts of 12,000 pounds with a supply pressure of only 60 psi.

SPRING RETURN ACTUATOR

Type 473 Actuator with spring safety device. In event of a supply pressure failure control valve will move into the closed position. Also available with spring for return to open position in event of plant air failure.

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SINCE 1880

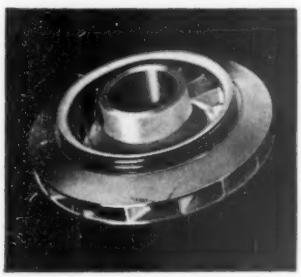
How high speed gas turbines make possible new Solar centrifugal compressor for industrial use

by Leon Wosika, chief of preliminary design
and John Glessner, project engineer
Solar Aircraft Company

The development of the high-speed industrial gas turbine is resulting in improvements in industrial equipment used in conjunction with these prime movers.

A practical centrifugal compressor for the low-volume range is one of the first of these developments.

Traditionally, reciprocating compressors have been used in the range from 500 to 1000 hp when suction pressures are from 200 to 800 psi and volume flows are 100 to 1000 cubic feet per minute at suction temperature and pressure.



It has long been known that a centrifugal compressor would be less expensive to own and operate in this range if high speed drivers were available. For example, direct drive speeds from steam turbines have been limited to 10,000 to 12,000 rpm. When gears are used to obtain high speeds, their cost and complexity has made the compressor-set look less attractive. So, in the range from 100 to 1000 suction cubic feet per minute, a low speed, conventionally designed centrifugal would have to employ compressor rotors of perhaps 15 inches in diameter, and would necessarily have very long, narrow flow passages – resulting in poor efficiency.

Now, however, the availability of industrial high speed drivers, particularly the Solar Saturn T-1000 gas turbine engine, has provided the impetus for Solar to design and build a line of efficient centrifugal compressors for the low volume range. The compressor uses compressor rotors seven inches in diameter. At approximately 20,000 rpm, wheel tip speed is only slightly over 600 feet per second, resulting in low pressure ratios per stage. High rpm and low tip speed plus careful design result in a high efficiency of 70 to 75 per cent.

High efficiency is not the only immediate advantage of Solar's compressor. When it is coupled with a gas turbine in the 500-1000 hp range, no gearbox is necessary since the turbine rotating speeds of about 20,000 rpm match those of the compressor.

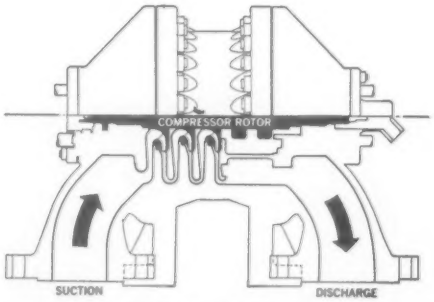
Together, the two machines make a lightweight, compact package – in the case of the Saturn T-1000 turbine, less than 7000 lbs and 300 cubic feet. This factor makes transportation and installation much easier and more economical than with the traditional compressor installation.

This portability makes central maintenance in a convenient, well-equipped shop a practical reality. In addition, the small size, light weight and absence of unbalance forces minimize foundation requirements.

A truly unique feature of the compressor is its modular design – the use of interchangeable staging to accommodate changing pressure and flow characteristics. High efficiency is maintained over the entire range of flows, 100 to 1000 suction cubic feet per minute, by use of pre-engineered, off-the-shelf compressor stages. Each stage is designed for a different flow, but is mechanically interchangeable with any other stage.

Several advantages result from modular design: (1) It reduces costs, mainly through volume production of parts and improved manufacturing methods. (2) It gives the compressor extreme service flexibility by allowing the quick change of stages in the field to accommodate new flows and pressures. (3) It allows quick delivery because all parts may be shipped directly from stock with no factory modifications necessary. (4) It tends to increase reliability and efficiency through repetitive manufacture of standardized parts.

If you wish additional data on either the compressor or the Saturn T-1000 turbine, or both, write Dept. H-167, Solar Aircraft Company, San Diego 12, Calif.



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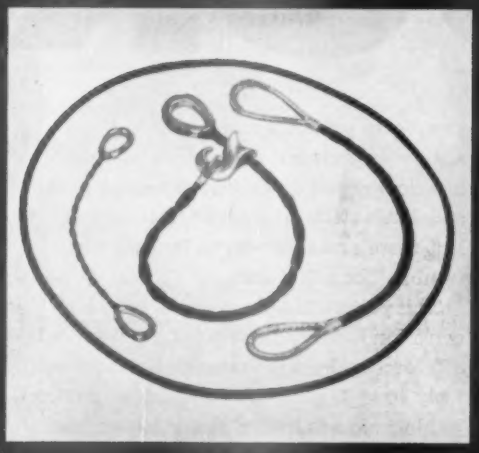

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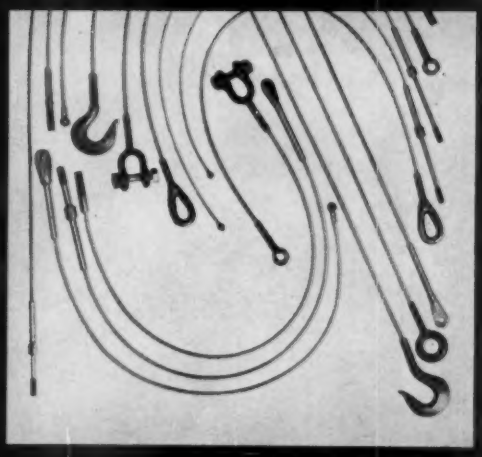

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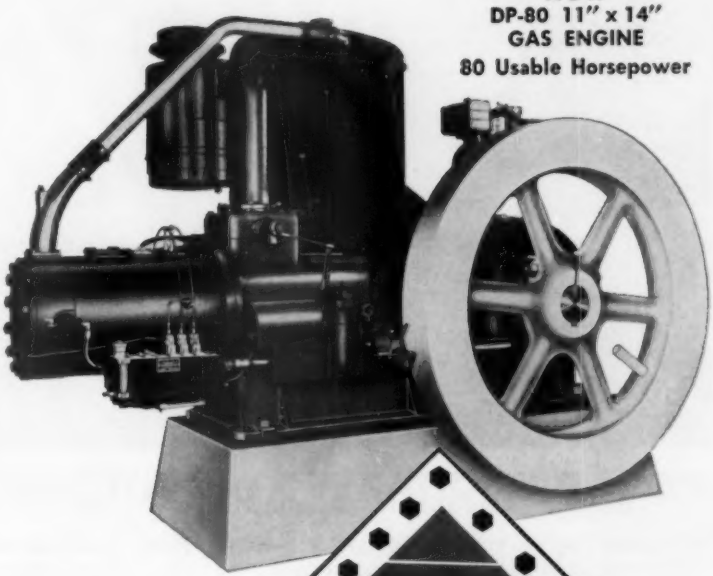

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SMOOTHER THAN STEAM

STEPS UP SPEED OF FRACTURING OPERATIONS BY 20%

Take it from Equipment Manager Tyra Lewis of Producers Chemical Company: "You have to have the kind of unhesitating power – with those full-power shifts – you get from TORQMATIC DRIVE to do a really good job of fracturing."

That's the big reason this Borger, Texas, company replaced stick shifts with TORQMATIC in all 7 of their units working the Borger-Pampa-Perryton area.

Ever since these TORQMATIC replacements were installed, these units have been doing a smoother, easier-to-control job. Operations have been 20% faster. Yet operators now require virtually no job-training–another big saving to Producers Chemical.

And that isn't all. With "smoother than steam" TORQMATIC DRIVES, all 7 units log far less down-time. That in itself is a big plus to any fracturing operation. But maintenance costs have also been cut – by a full 25%. It's easy to see why Producers Chemical is planning to TORQMATIC equip still another unit soon.

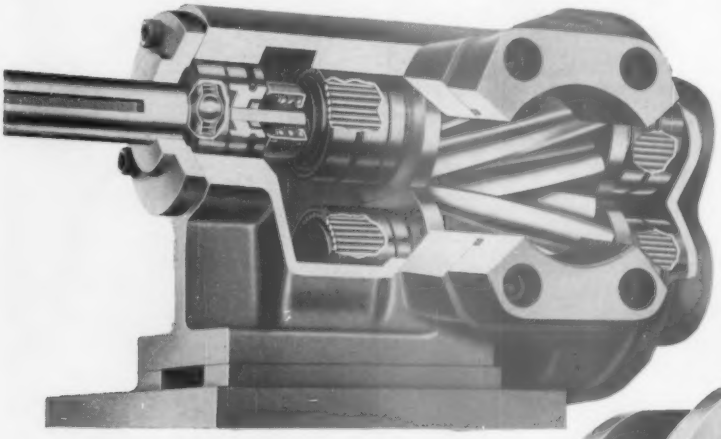
Like to cash in on big time- and money-savings like these in your drilling, servicing or fracturing operations? All it takes is equipment with Allison TORQMATIC DRIVE –installed by leading oil field equipment manufacturers. See your dealer or write Allison Division of General Motors, Indianapolis 6, Indiana. In Canada: General Motors Diesel Limited, London, Ontario.

Allison

TORQMATIC® DRIVES

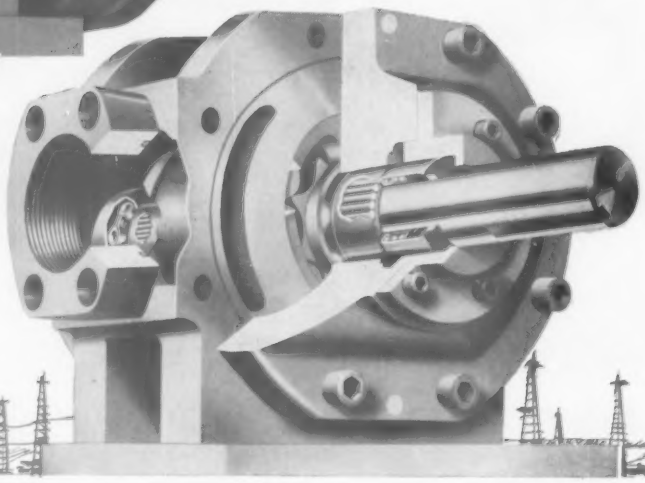
THE MODERN DRIVE FOR MODERN EQUIPMENT

Now from Brown & Sharpe,



New B&S Series 300, rotary-gear pumps are available for pressures to 300 psi; caps. of 40, 60, 90, 125, 175 gpm.

New B&S Series 700, gerotor-type pumps for pressures to 1000 psi; caps. of 20, 30, 40, 60, 80 gpm. (Note: This highly-efficient pump has unusually long life. Contact between its inner and outer elements progresses at only 1/9 driven speed.)



a brand new line of Rotary Pumps with 5 big advantages to cut maintenance costs

1 Standard bolts and screws are used throughout. If lost, they're quickly and easily replaced.

2 Simple, rugged construction. Pumps are easy to take care of because they're easy to understand.

3 Choice of threaded or plain pipe flanges, both easily replaced.

4 Roller bearings give you longer service from pumps before any maintenance is required.

5 Replaceable wear plates are easily changed — give new life to the pumps, after normal wear.

Reduced maintenance cost is just one of the reasons why you appreciate these new pumps. You save on installation and get longer life, too.

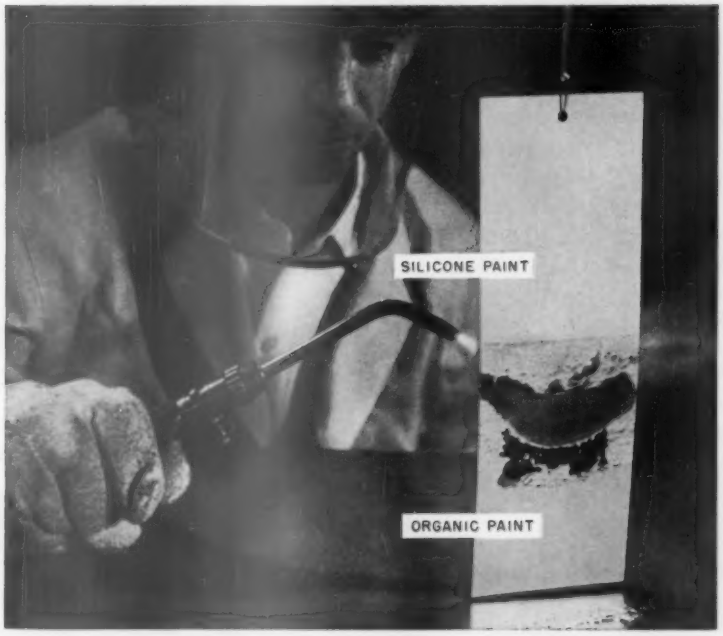
Brown & Sharpe Series 300 and Series 700 Pumps are designed specifically for the Petroleum Industry, to save you money right down the line.

Start saving now! Contact your local oil field supply store about new B&S Pumps. Ask them for a catalog, or write: Hydraulics Div., Brown & Sharpe Mfg. Co., Providence 1, Rhode Island.

Brown & Sharpe PRECISION CENTER

SILICONE NEWS from Dow Corning

New Paint For Hot Spots



Silicone-based paints stay put ...resist corrosion, weathering

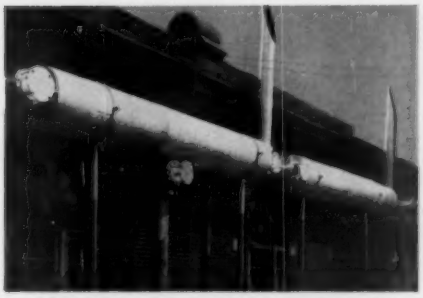
Guarding metal surfaces from weathering and chemical attack is tough enough. Keeping them protected when surface temperatures climb to 700 F, 800 F — even 1000 F — is tougher still. Most paints fail rapidly, blister and peel. But paints based on Dow Corning Silicones retain their protective properties, even on the hottest jobs.

Whether the surface stays hot, or shuttles between hot and cold, makes no difference to a silicone paint. Here's a new kind of protective coating . . . one that you can depend on to provide real protection, withstand oxidation, corrosive atmospheres or weathering. When paint lasts like this — from 25% to 100% longer — you save money because (1) less paint is required; (2) costly downtime and labor are greatly reduced.

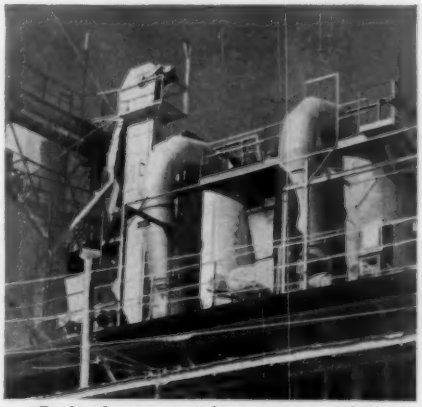
Another plus: Silicone-based paints are available in a wide range of colors. This means you can carry color-coding over onto hot equipment without worrying about early paint failure. To new product designers, this feature means finishes that resist chalking, checking, fading — retain their original beauty and protection.

For protecting a "hot spot" or a "hot product", it'll pay you to use paints made with Dow Corning silicone resins. Write today for more information.

"After 5 years, silicone paint still protects bronze-melting furnace. Organic paints failed within days after application."
BEARING MANUFACTURER



"After two years, mufflers coated with silicone paint are still in good shape. Organic paint used on similar 500 F mufflers burned away long ago."
PUBLIC UTILITY



"By far the most satisfactory paint we have ever used on kilns and stacks with surface temperatures of 650 to 750 F."
BASIC CHEMICAL MANUFACTURER

Send for illustrated brochure, "Why Silicone-Based Paints Mean Less Maintenance", plus list of suppliers. Address Dept. 6210.

first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

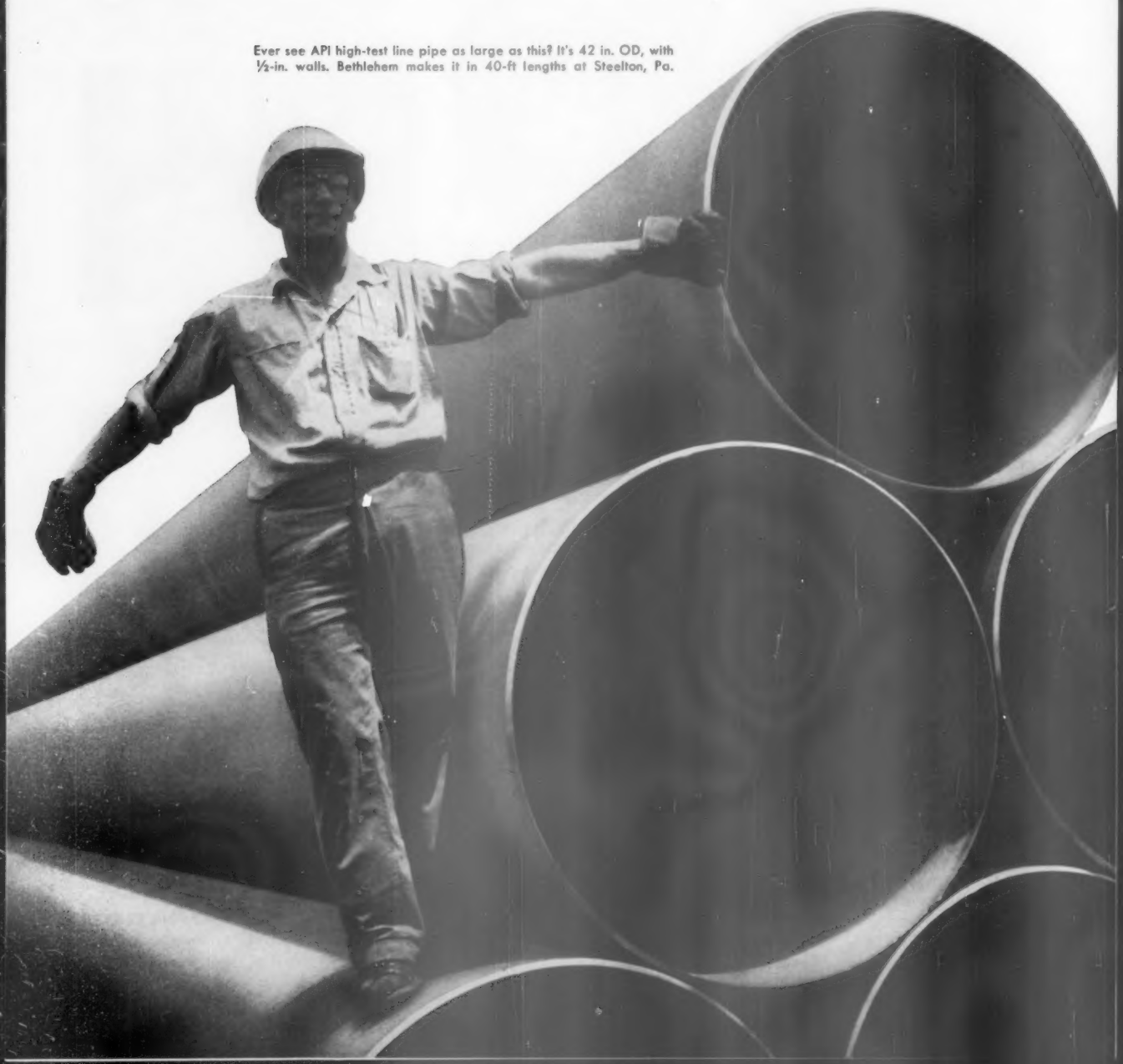
ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D. C.

Need 42-in. Line Pipe?

Bethlehem makes it—electric fusion-weld line pipe from 18 through 42 in. OD, and with walls to ¾ in. in all diameters. Meets all applicable parts of API 5LX specifications. It's made at Steelton, Pa., on a completely modernized mill with capacity of over 35,000 tons a month.

Included among our newly installed facilities are edge and end planers, a U-ing press, an 18,000-ton-capacity hydraulic O-ing press, and batteries of inside- and outside-seam welding machines. The pipe is expanded hydraulically and end-faced.

It's a smooth-flowing, highly automated operation. Production is fast—quality is tops. For more information, call or write the Bethlehem sales office nearest you.



Ever see API high-test line pipe as large as this? It's 42 in. OD, with ½-in. walls. Bethlehem makes it in 40-ft lengths at Steelton, Pa.

How about 62-ft lengths?

Extra-long cars were required to ship this large order of Bethlehem 8⅝ in. ERW line pipe from our Sparrows Point, Md., mill. Lengths reached to 62 ft—that's mighty long pipe!

Bethlehem makes it—electric resistance-weld line pipe from $5\frac{9}{16}$ to 16 in. OD in lengths to 62 ft. Our modern pipe mills at Sparrows Point, Md., are regularly turning out these longer lengths for installation all around the country. Pipeliners like 'em, since they mean fewer welds in the field.

Bethlehem line pipe speeds up line construction in other ways, too. It's good, sound pipe, tested and re-tested at the mill to make sure it will test out OK in the line. Every length is straight as a stretched string, round in the body, and square and accurately beveled on the ends. It's pipe that will line up fast and take a good weld every time.

When you need l-o-n-g lengths of top-quality line pipe, call on Bethlehem. We have a sales office near you.

Steel

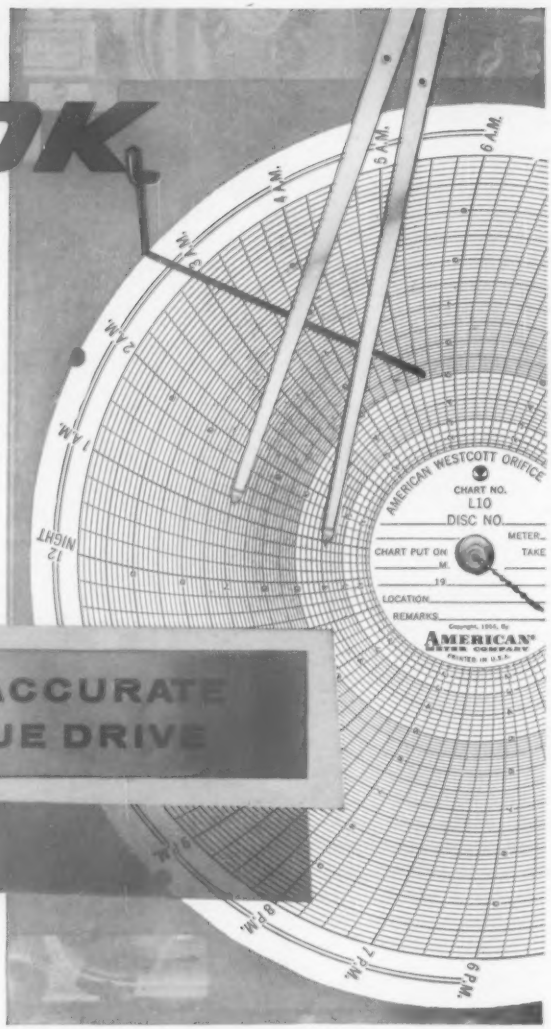
for Strength
. . . Economy
. . . Versatility

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

AMERICAN®
GASCLOK
POWER DRIVE



Check these features--

- **Completely self-contained gas or air-powered instrument driving and timing unit for long, trouble-free operation in remote locations.**
- **Constant high power...more than 20 times the torque delivered by conventional spring-wound mechanisms.**
- **Timing accuracy continuous...no heavy "mainspring" to weaken or run down...unaffected by a ± 20% variation in supply pressure.**
- **Self-starting...no winding or priming of power unit.**

VERSATILE • ACCURATE
HIGH TORQUE DRIVE

- **Flexibility...ideal as original or replacement equipment for strip chart and conventional circular chart instruments.**
- **Built-in durability...timing mechanism internally sealed to prevent corrosion...large area internal ports prevent clogging.**
- **Rugged dependability...all power unit parts exposed to gas are aluminum or stainless steel...inherently explosion proof.**
- **Economical...normal air or gas consumption 5 cfh...operating pressure 5 psi...rotation 2 rpm.**

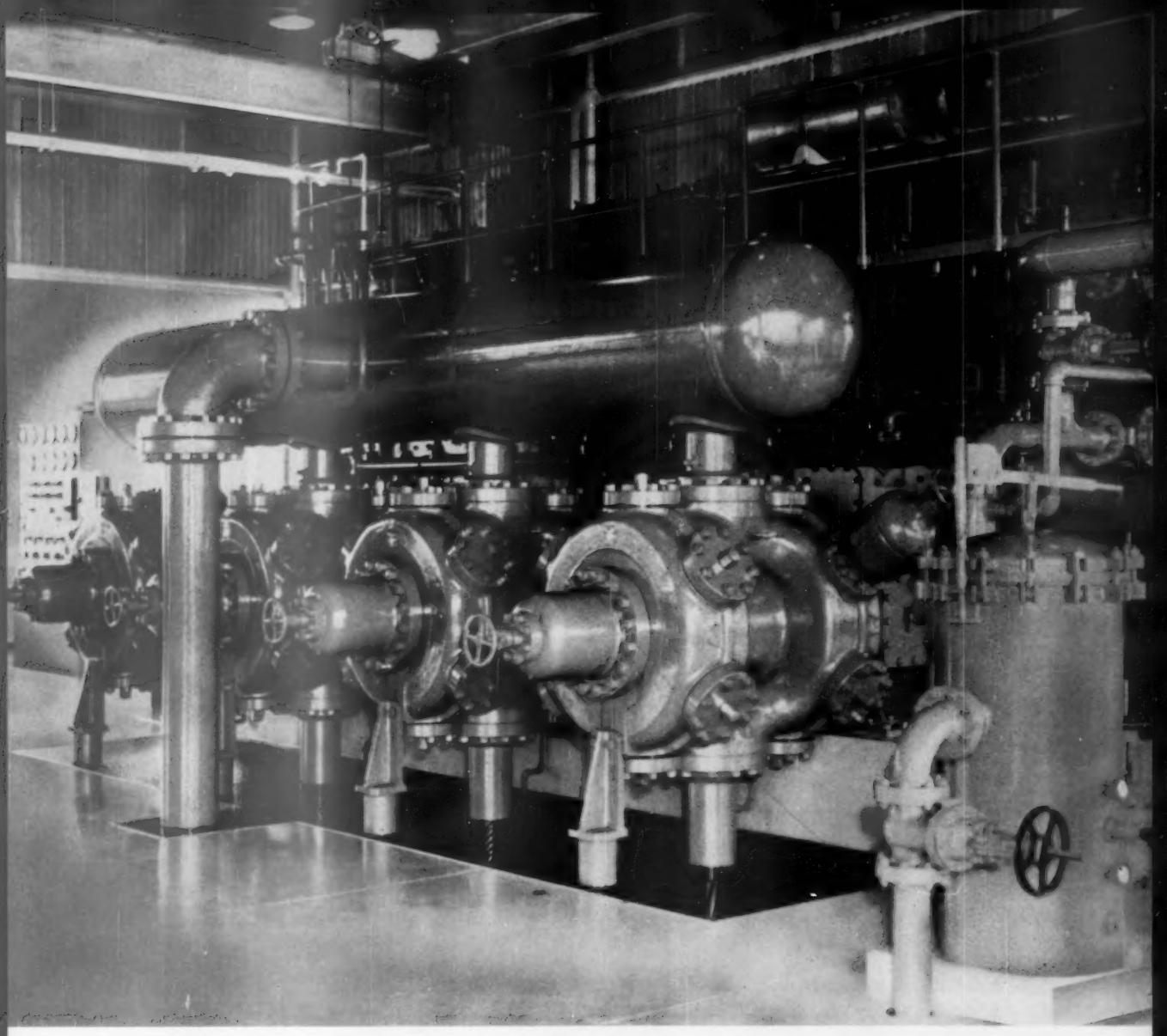
Then ask
your American representative how the versatile ***GASCLOK*** can provide new metering accuracies and economies for you.

AMERICAN METER CO

AMERICAN®
METER COMPANY
INCORPORATED (ESTABLISHED 1836)

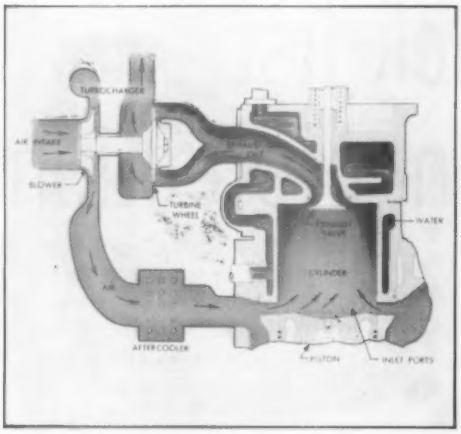
GENERAL SALES OFFICE: Philadelphia 16, Penna. • Albany • Alhambra • Atlanta Baltimore • Birmingham • Boston • Chicago • Dallas • Denver • Erie • Houston Kansas City • Los Angeles • Minneapolis • New York • Omaha • Pittsburgh • San Francisco • Seattle • Tulsa • Wynnewood • IN CANADA: Canadian Meter Company, Ltd., Milton, Ontario • Calgary • Edmonton • Regina

SUPPLIERS TO THE GAS INDUSTRY for Ironcase, Tinned Steelcase, Aluminumcase and Welded Steelcase Meters • American-Westcott Orifice Meters • Instruments • Reliance Regulators • Apparatus • Valves



At Northern Natural's Clifton Station, this SUTC engine compressor operates

20 HOURS A DAY...FOR 3 STRAIGHT YEARS



Self-sustained turbocharging at any speed and load is possible because of SUTC's exclusive Uniflo scavenging.

Five years ago a remarkable new engine compressor was introduced.

Called the SUTC, this Worthington turbocharged 2-cycle engine compressor was unlike any other. Combustion air enters thru side inlet ports, *but the exhaust is thru overhead valves.* Valve timing can be arranged to give maximum supercharging effect.

On paper, straight-thru or "Uniflo" scavenging has many advantages. The turbocharger operates over the entire speed and load range without help from external sources. Scavenging efficiency is increased and pulsations practically eliminated.

Now came the real test. More than 130,000 hp were installed. Operators praised the SUTC's exceptionally smooth, quiet operation. Operational records confirm the machines reliability. Unit G-2312 is typical. This 8 cylinder, 2000 hp SUTC engine compressor was installed in 1957 in Northern Natural Gas Company's Clifton, Kansas Station. To date, it has logged over 20,000 hours—an average of more than 20 hours a day for 3 straight years. A sister unit installed last year has equalled this performance.

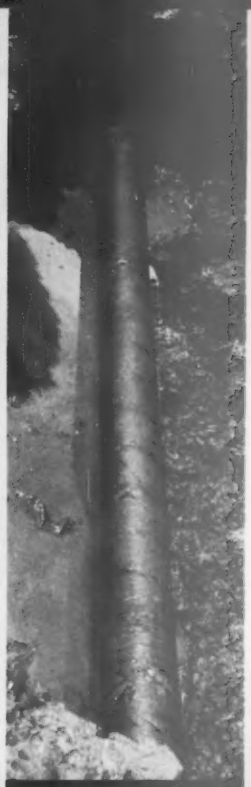
May we send you complete data on this unique engine compressor? Please write to H. C. Barten, Worthington Corporation, P.O. Box 953, Buffalo 5, N.Y.

WORTHINGTON

1

custom specifications:

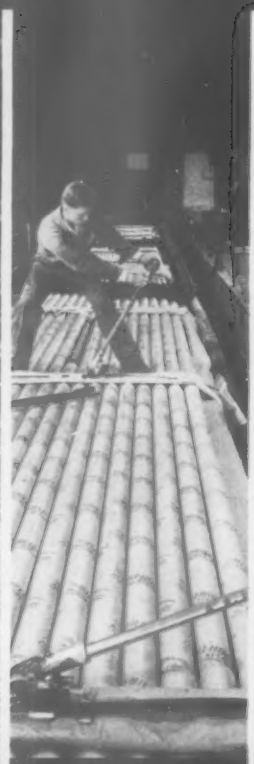
Over 30 separate specifications for custom corrosion prevention.



2

predictable performance:

Thirty year-old installations still providing uninterrupted service.



3

prompt deliveries:

All mills strategically located near pipe sources and shipping facilities.

4

stockpiling service:

Purchase pipe to your advantage — store at Hill Hubbell yard.

5

"mill" quality:

Finest materials mill-applied under carefully controlled conditions.

DO YOUR PIPELINE PROTECTION DOLLARS BUY ALL SEVEN?

Hill Hubbell's check list for full corrosion protection

6

single source:

One processor for all pipe — any diameter, length or quantity.

7

customer satisfaction:

Guaranteed by over 32 years of reputable service to the pipeline industry.

Individual customized protection for each customer's specific corrosion problem has been Hill Hubbell's forte for over 32 years. That's why we have *more than 30 separate specifications* to meet any protection requirement. You buy only the protection you need, and you get the best materials and craftsmanship your money can buy.

In addition to sound protection for your pipelines, doing business with Hill Hubbell offers a host of other advantages. All guesswork originating in over-the-ditch application is completely eliminated at Hill Hubbell's modern coating, wrapping and lining mills. And, with our yard facilities at your disposal, you can take advantage of buyer's markets for your pipe purchases. We store it until you need it.

Remember too, you get *proved protection.* Hill Hubbell coating and wrapping has earned a reputation for reliability and durability through pipeline installations still in near-new condition after 30 years of trouble-free performance in extremely corrosive environments. No need to risk your pipeline (or your reputation) on unproved protection.

On your next job specify Hill Hubbell—the name synonymous with quality in coated-and-wrapped pipe.

Specify Hill Hubbell wrapped pipe on your next job . . .

HILL HUBBELL

FACTORY APPLICATORS OF COATINGS AND WRAPPINGS

3091 MAYFIELD RD. • CLEVELAND 18, OHIO • YELLOWSTONE 2-7535

ATTENTION: Are you vitally interested in corrosion prevention?

Then sign up for Hill Hubbell's free publication, "Progress Report on PROTECTION". Published quarterly, it provides timely information about new installations, corrosion prevention and other topics. Fill out the attached blank and mail to: Hill Hubbell Co., 3091 Mayfield Road, Cleveland 18, Ohio.

(please type or print)

NAME & TITLE _____

ADDRESS _____
street

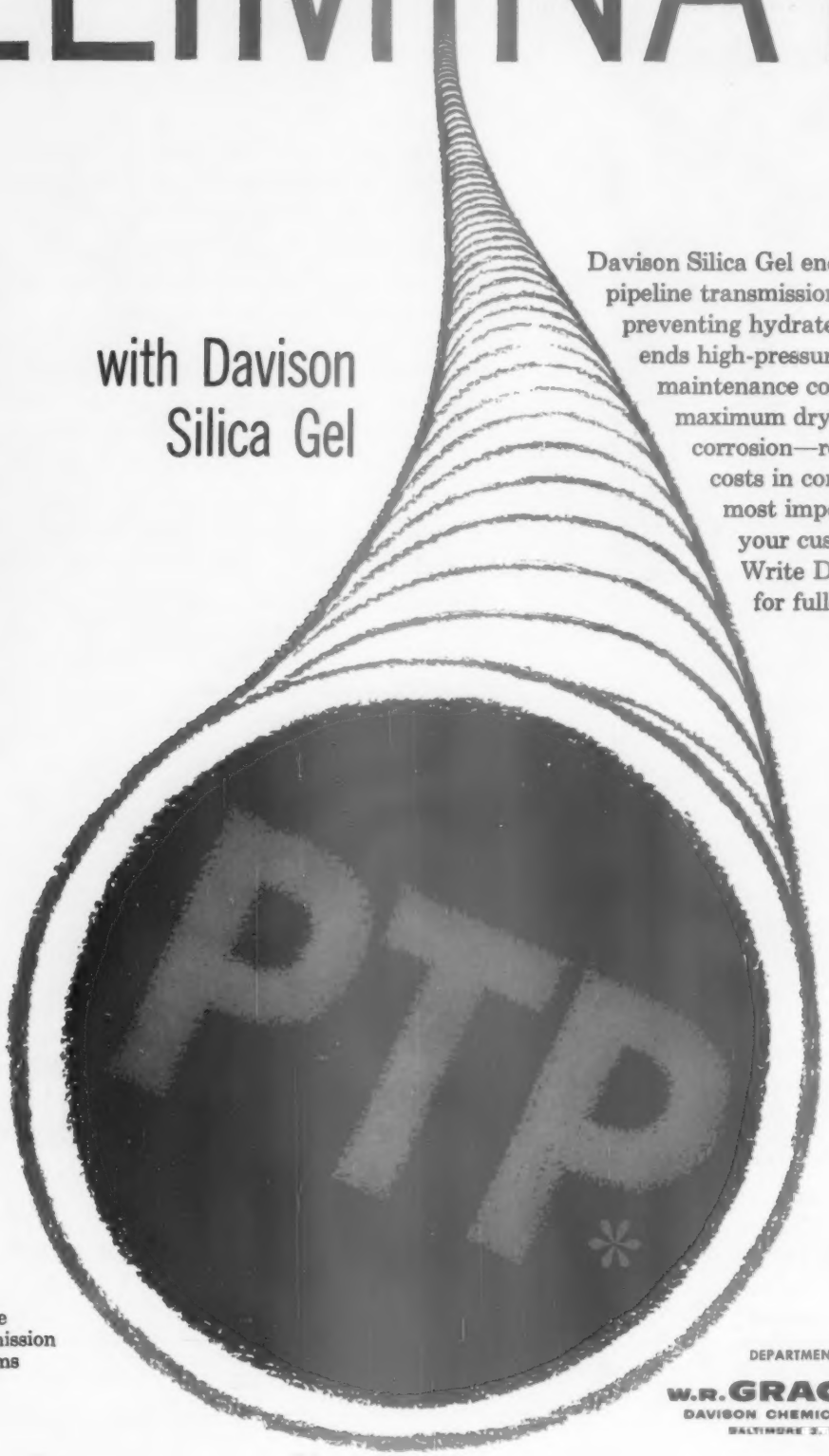
_____
city zone state

COMPANY _____

ELIMINATE

with Davison Silica Gel

Davison Silica Gel ends natural gas pipeline transmission problems. By preventing hydrate formation, it ends high-pressure losses—lowers maintenance costs. By providing maximum dryness, it decreases corrosion—reduces power costs in compression—and, most important, keeps your customers happy. Write Dept. 3110 today for full information.



* Pipeline Transmission Problems

DEPARTMENT 3110

W.R. GRACE & CO.
DAVISON CHEMICAL DIVISION
BALTIMORE 3, MARYLAND

SAVE THE BEAN (and money)--throw the hole away!

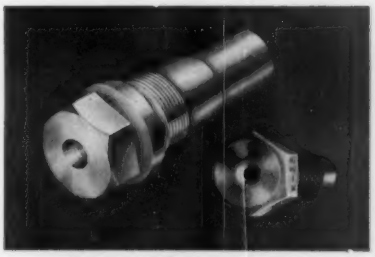
Specify UNIBOLT master beans and low-cost inserts

With ordinary care, a single UNIBOLT Master Bean will last for the entire flowing life of a well. These beans are threaded to receive an inexpensive screw insert. The cutting action of sand-laden production is imposed on the expendable insert, not the master bean.

The inserts are not only inexpensive, they are easier to change than regular beans. Drilled in increments of 5% and 10% of well flow, as well as in increments of 1/64th inch, these inserts provide the versatile range of an adjustable choke with the fine accuracy of a positive orifice.

This is only one of a number of refinements in flow bean design perfected and introduced by UNIBOLT. Others are: shaped entrance to reduce turbulence and maintain flow accuracy, "flow-rating" as a standard inspection procedure to insure correct orifice sizing, and special analysis alloys and heat-treatments for corrosion and wear resistance.

So, when you're thinking about Christmas trees, remember the UNIBOLT Positive Choke Bodies and Cage Nipples that let you save the bean, throw the hole away!



A Unibolt Master Bean and renewable, low-cost, insert.

UNIBOLT

THORNHILL CRAVER CO.

P. O. Box 1184, Houston, Texas

Valves, Fittings, Flanges... Rockwell-Nordstrom, OIC, W-K-M, Stockham, Taylor Forge... Line Pipe by Jones & Laughlin— these and other famous products from J&L Supply enable you to design and...

Build a Better Pipeline!

Fast, economical pipeline construction and dependable operation are assured with J&L Electricweld Line Pipe.

High ductility for easier field bending and ends that are uniformly round to line up quickly for fast, dependable welding will speed your lines across even the most rugged terrain.

Multiple testing of every length of J&L Electricweld Line Pipe assures top performance during installation and operation. J&L testing includes ultrasonic inspection of the weld area, hydrostatic pressure testing, visual inspections, flattening tests, and magnaflux examination of both ends of every joint.

J&L Electricweld is available in sizes from 6⅝" O.D. to 12¾" O.D. J&L Seamless Line Pipe is produced in sizes from 2⅜" O.D. to 14" O.D.

Above, Rockwell-Nordstrom valves doing sentinel duty on the manifold of a terminal at a products pipeline station. Flanges and welding fittings are by Taylor Forge.

Pipelines throughout the nation are constructed and maintained more economically with products sold by J&L Supply . . . the best available.

Ask your J&L Supply man for technical material on pipeline products.

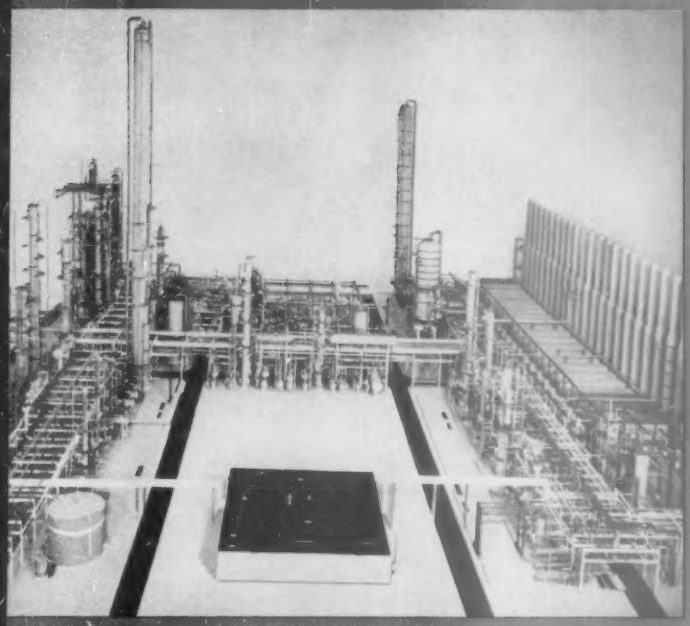
Jones & Laughlin

SUPPLY DIVISION – Tulsa

If it's sold by J&L . . . .

It's the best available

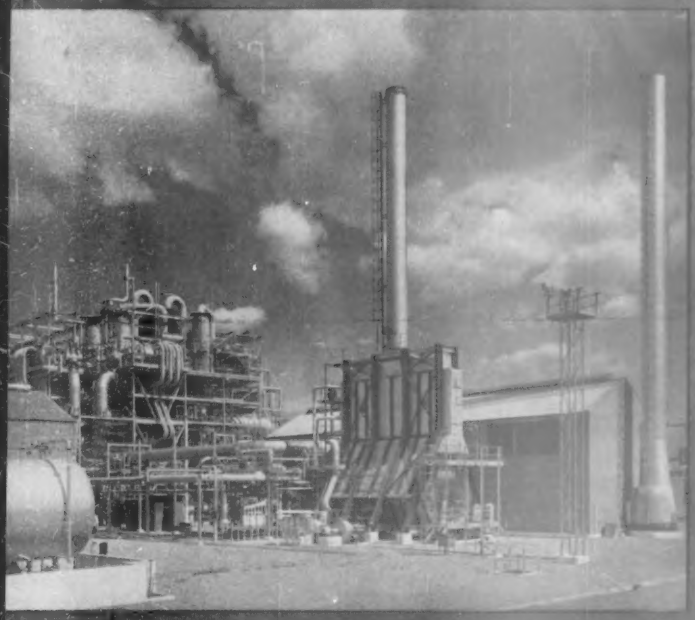
Kellogg Engineers and Builds World's Biggest Olefin Plants



Mobil

FUTURE WORLD'S LARGEST is Socony Mobil Oil Company's ethylene plant at Beaumont, Texas. It is the first large plant in the U.S. to crack naphtha into olefins. Engineered by The M. W. Kellogg Company, as shown in this scale model, it is scheduled for completion by Kellogg by 1961. Capacity will be 380 million pounds annually of 99.9% purity ethylene.

This newest plant consists of steam pyrolysis, gas treating, and product recovery sections. It has been designed to handle simultaneously both liquid and gaseous feedstocks. In addition to ethylene, major products will include propylene, propane, a B-B product, gasoline, and fuel oil.



ICI

LARGEST OUTSIDE THE U.S. is the English Wilton Works of Imperial Chemical Industries, which now includes three olefin plants. Photograph shows Plant No. 3. All are the result of close engineering cooperation between Kellogg and I.C.I. Together, they represent a current output of 110,000 tons per year of high-purity ethylene, and a potential of 140,000 tons.

Plant No. 1, commissioned in 1951, was the first full-scale adoption of the then novel process of oil pyrolysis developed in Kellogg's laboratories. Its success led to the addition of Plant No. 2 in 1956, and then to No. 3—representing a 60% increase in olefin capacity—in 1959.

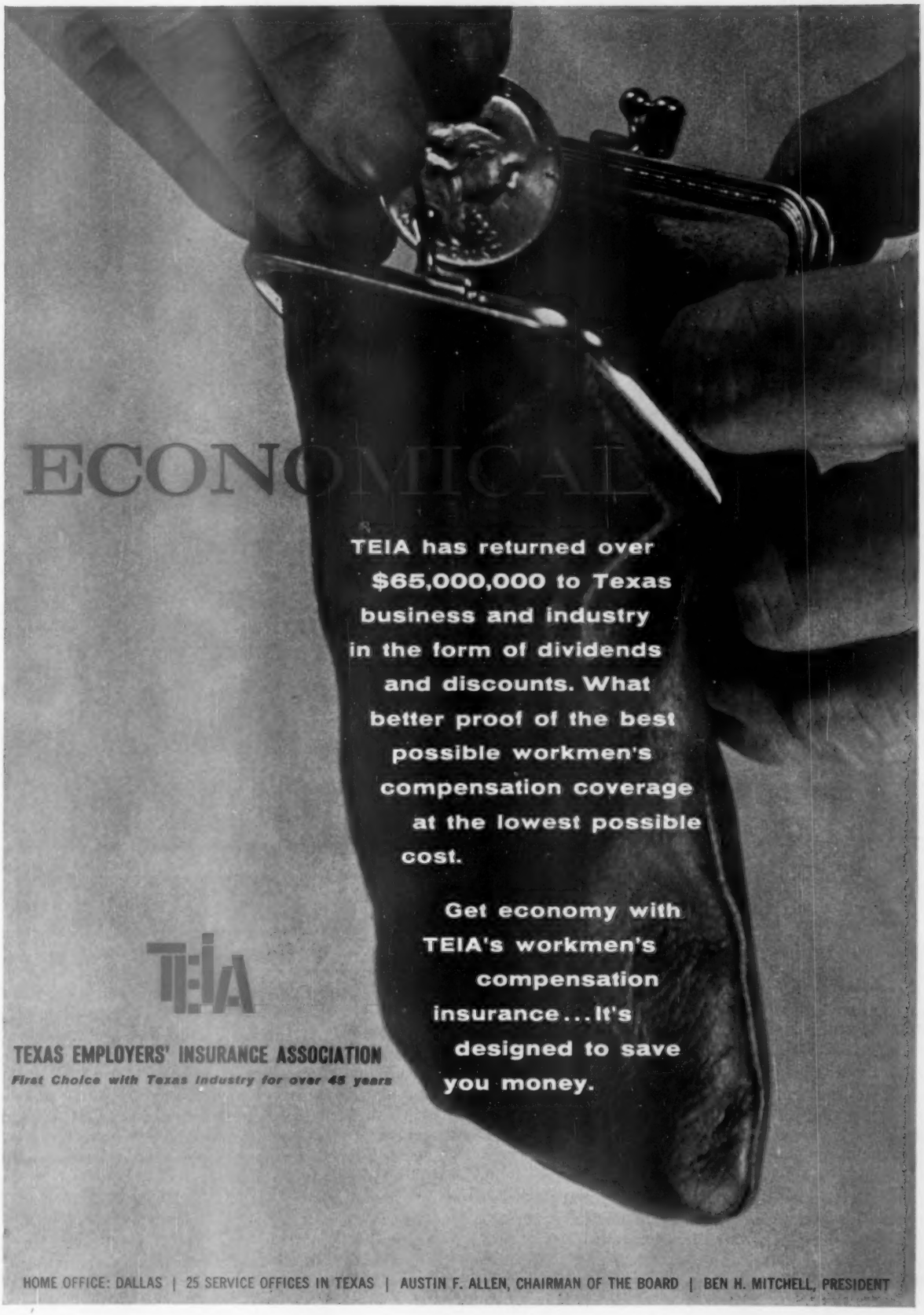
Whether your approach to ethylene is through the steam pyrolysis of hydrocarbons or the recovery of ethylene from gas mixtures, Kellogg has developed processes which can assure the optimum investment, operating costs, product purity, and yield. For more information about Kellogg's 2-billion-pound background in engineering and/or building ethylene plants, write for a copy of "Olefin Plants" Kelloggram.

M KELLOGG W

THE M. W. KELLOGG COMPANY

711 Third Ave., New York • Subsidiary of Pullman Incorporated

Offices of other Kellogg companies are in Toronto, London, Paris, Rio de Janeiro, Caracas, Buenos Aires


ECONOMICAL
TEIA has returned over $65,000,000 to Texas business and industry in the form of dividends and discounts. What better proof of the best possible workmen's compensation coverage at the lowest possible cost.
Get economy with TEIA's workmen's compensation insurance... It's designed to save you money.
TEIA
TEXAS EMPLOYERS' INSURANCE ASSOCIATION
First Choice with Texas Industry for over 45 years
HOME OFFICE: DALLAS | 25 SERVICE OFFICES IN TEXAS | AUSTIN F. ALLEN, CHAIRMAN OF THE BOARD | BEN H. MITCHELL, PRESIDENT

5 LEADING REGIONAL OIL AMERICA'S LEADING

To serve you better coast-to-coast, 5 leading regional oil companies have joined hands to form a new Humble Oil & Refining Company. The name comes from an oil field and a town near Houston, which was the origin of Humble Oil Company almost 50 years ago.

In the fast developing Age of Energy, this is an important move. It joins the skills and resources of all these companies into a single closely-knit organization that now markets products coast-to-coast.

The new Humble is America's Leading Energy Company. It finds, refines, distributes, and markets more natural gas, oil and petroleum products for America's growing needs, than any other domestic oil operation. It is backed by the leading petroleum research laboratories in the nation . . . with more oil and petrochemical advances to their credit than any other U.S. Research group. This new organization under Humble Management offers opportunities for greater efficiencies in oil exploration, drilling, production, transportation and marketing.

The new Humble Oil & Refining Company looks forward to expansion in two important areas.

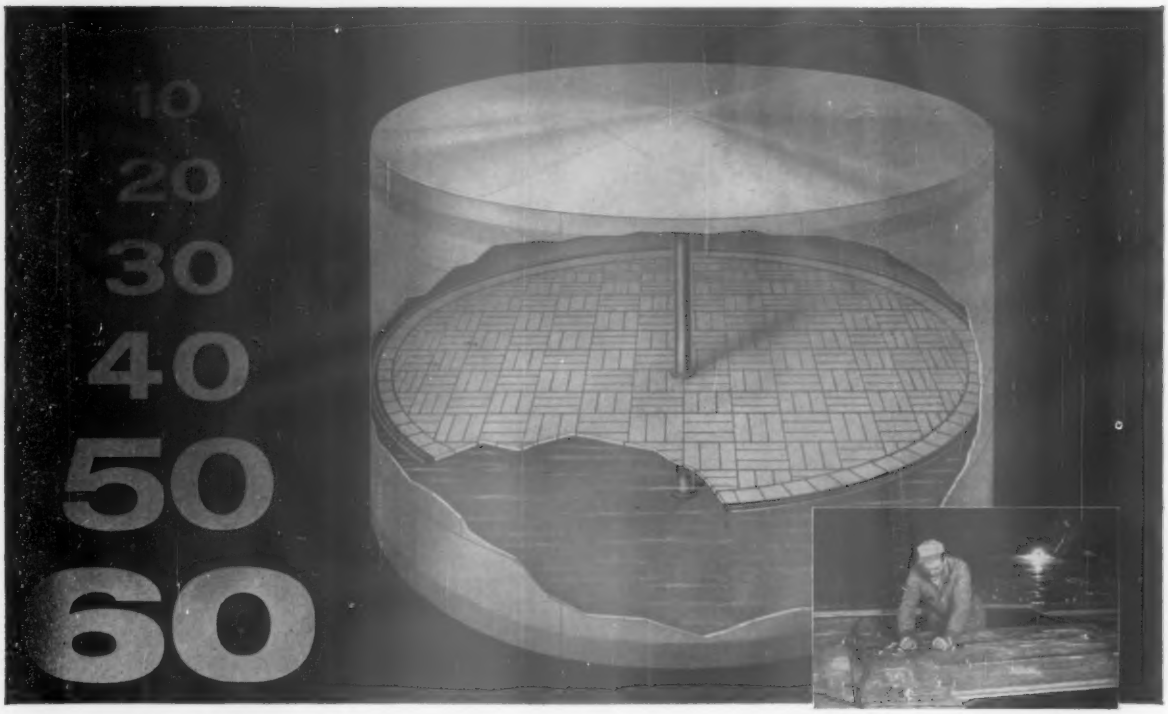
Geographical expansion – as a marketer with more than 30,000 service stations, now enabled through this move to operate in all 50 states.

New product expansion – not only in improved fuels and lubricants, like the remarkable new Uniflo Motor Oil, but also in the exciting new field of petro-chemistry where hundreds of new and useful products have been improved or developed because of Humble research.

COMPANIES UNITE TO FORM ENERGY COMPANY

IDENTIFIED COAST-TO-COAST BY THESE FINE TRADE MARKS

HUMBLE
OIL & REFINING COMPANY



70 ft. HAMONDFLOTE COVER

converts old riveted vessel to modern floating roof tank

A rigid foam plastic Hamondflote Cover was quickly and easily installed in this 70 ft. diameter riveted tank. Using conventional hand tools in a simple assembly operation, maintenance personnel converted the vessel to an efficient conservation tank.

SIZE IS NO LIMITATION . . . the Hamondflote Cover can be used to modernize tanks up to any diameter in use today, regardless of the number or location of supporting columns. It reduces evaporation losses by as much as 95%, is completely resistant to a wide range of chemicals and petroleum hydrocarbons and will withstand temperatures from −94°F. to +300°F.

Write for bulletin which tells the entire Hamondflote Cover story.

1. Sections of the Hamondflote Plastic Cover are easily put together with tongue and groove joints and simple hand-tightened clamps.

2. Here the 70 ft. Cover is almost completed. Note that it is strong and rigid enough to support the workman's weight.

3. Rivets, columns and other protrusions on the inside wall of the tank present no problems. The flexible packing gland easily slides over them when the roof is rising or falling with the liquid level.

HAMONDTANK — 12 plants to serve you coast to coast — PDM

Pittsburgh-Des Moines Steel Company

Plants at PITTSBURGH, WARREN, BRISTOL, PA. • BALTIMORE • BIRMINGHAM • DES MOINES
PROVO, UTAH • CASPER, WYO. • SANTA CLARA, FRESNO, STOCKTON, CALIF.

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"Sometimes I Think We Could Treat the Oil Just by Setting a Drum of Visco on the Lease"

Reports on Emulsion-Breaker Performance with Visco 485 ... A Typical Visco Formula

Visco 485 is one of dozens of emulsion-breaker formulas that Visco has developed for specific production areas and well conditions. It has taken off like a rocket—often producing dry oil to storage on leases where tank rolling was routine . . . and proving once again that "the tough jobs go to Visco"!

Here are a few instances where Visco 485 has solved difficult treating problems—one of which led to the optimistic statement in the headline.

Rough Gas-Cut Oil and Acid Water

First 200-barrel tank from this new well had had 12 gallons of chemical and as much as 150° of heat . . . 1.0% water was still held up. Five gallons of Visco 485, and 30 minutes' rolling were all it took to sell the tank at 0.2% water.

Cut Chemical Feed 66%

Retreating was common on this lease. 80 to 90 barrels of oil per day took 1½ gallons of chemical. Test of Visco 485 produced 0.1 to 0.2% water in oil with only ½ gallon per day treatment. Results are uniformly good; superintendent plans to put Visco 485 on all remaining leases in the field.

Lowered Gas Heat Bill $300/Month

High tank bottoms, high heat, high treating costs—then Visco 485 and Visco 958 Paraffin Inhibitor were plant tested. Chemical consumption dropped from 10 quarts/500 bbls. to one quart 485 and 2 quarts 958. Tank bottoms disappeared. Heat was lowered from 125°F. to 70°F. for a $300/month gas bill saving. Lowered treating costs with Visco are capped with better oil quality.

Marvel Treater and 485 Cut B.S. & W. 20%

Oil from a new well was 19° gravity, pour point 51°F., 54% asphalt, 21% B.S. & W. Visco 485 was thoroughly dispersed in this heavy crude with a Marvel Treater. Result: 0.4% B.S. & W. Tests without the Marvel Treater could not bring B.S. & W. below 2.3%.

Visco sells or leases Marvel Treaters as an added Visco service to producers. Detailed data will be sent promptly on request.

Try Visco On a Tough One

Pick a well that is giving you emulsion-breaker troubles . . . high treating costs, tight emulsion, tank bottoms or heating problems. Let your Visco Field Service Man make a plant test for you. Odds favor him to come up with answers that can help you cut costs—and get dry oil, too. Call or write for Visco action today.

VISCO PRODUCTS COMPANY
Incorporated
A Unit of Nalco Chemical Company
1020 Holcombe Boulevard **Houston 25, Texas**

Deutsche Nalco-Chemie, G.m.b.H., Frankfort, Germany
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Nalco de Venezuela, C.A., Caracas, Venezuela

Visco® . . . *Serving the Oil Industry through Practical Applied Science*

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DODGE

DART PICKUP

NEW FROM DODGE FOR '61

THE FIRST AND ONLY TRUCK WITH COMPACT-ECONOMY

Compact diet. Compact upkeep costs. Compact in everything but work capacity. A full half-ton hauler that'll do the dirty jobs every day, day in and year out. New right down to the wheel studs. New cab. New body. New and easier clutching, shifting, handling. Even a new soft sound. New Dart Power Six, overhead valve, 225-cubic-inch engine that will actually deliver more miles per gallon than Ford and Chevrolet. That's how our tests worked out. And we wouldn't talk about it if you couldn't get the same results. The engine is slanted 30 degrees from the vertical for top-notch manifolding, both intake and exhaust. **THE '61 DODGE LINE?** All Dodge, all tough from end to end. Conventional and cab forward models, four-wheel drive series, Town Wagons for toting men and tools. Six and V8 gasoline power. Cummins diesels. A weight spread of 4300 lbs. GVW to 76,800 lbs. GCW. **PRICE?** The new Dart Pickup and the whole 1961 Dodge line of trucks are priced to compete with every truck coming or going. What more do you want? See your Dodge dealer now!

DODGE 4-WHEEL-DRIVE PICKUP Compact-economy plus the off-the-road agility of a mountain goat. Built to go anywhere you want to go without a whimper. Low-priced, too.

A PRODUCT OF CHRYSLER CORPORATION

Return visit to a sweet-running "package"

Here he is again—on one of his return visits—making sure that the unit is in top-running condition . . . providing the on-the-spot attention that Gardner-Denver oil field customers expect and get.

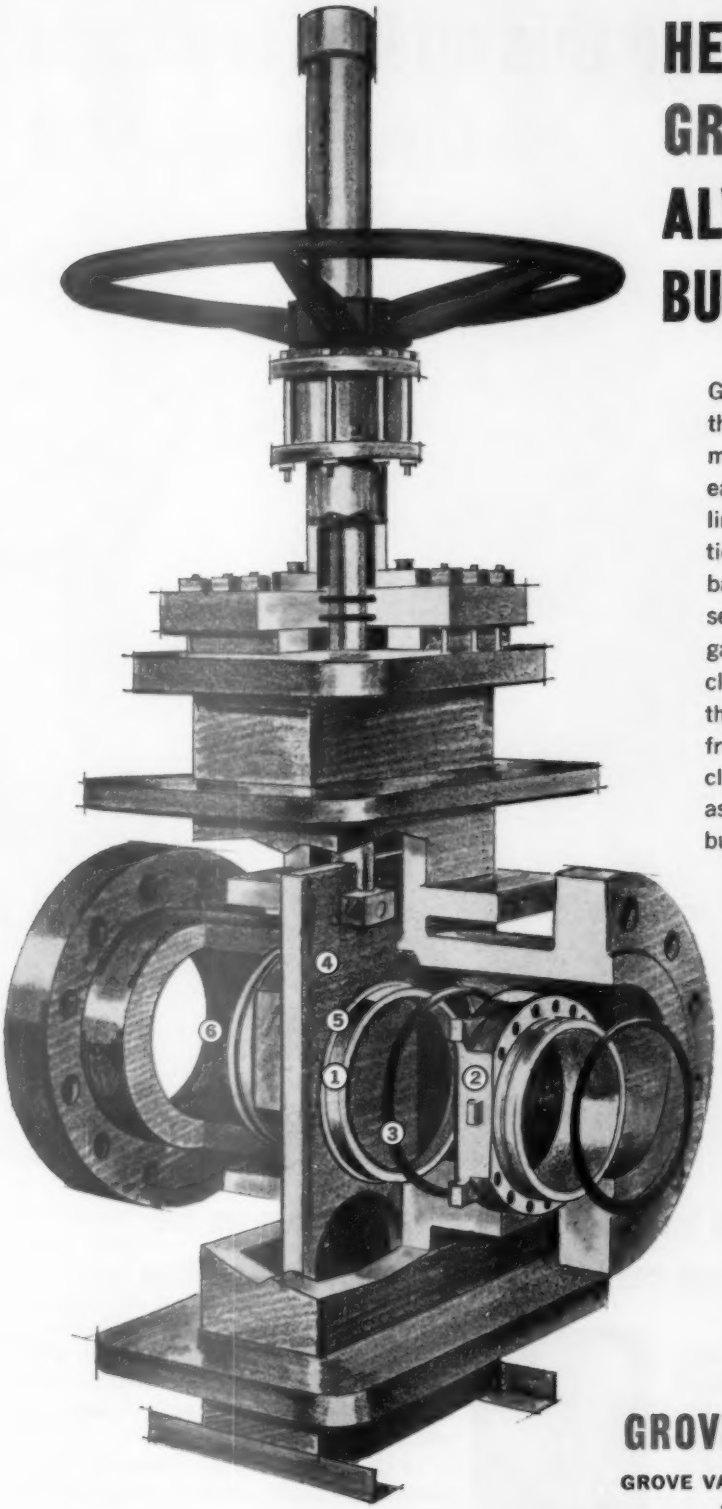
The Gardner-Denver Gas Compressor Specialist knows this installation because he was in at the start. Working from the petroleum engineer's specifications, he selected the right Gardner-Denver compressor . . . chose the cooling system, separators, controls and power unit. In short, he engineered a complete package—supervised assembly and field start-up. That's why it pays to consult your Gardner-Denver Petroleum Specialist for quality equipment backed up by genuine interest in the job it will do for you.

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER - DENVER

Gardner-Denver Company, Quincy, Illinois

In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario



HERE'S WHY A GROVE G-4 VALVE ALWAYS GIVES A BUBBLE-TIGHT SEAL

Grove protected Seal-"O"-Ring® system is the heart of the G-4. Inner (1) and outer (2) metal seat rings shield the o-rings (3) on each side of the gate (4) from damage by line contaminates. Inner seat rings also function as a primary metal-to-metal seal (5) backed up by the o-rings. No lubricants or sealing compounds are needed. The floating gate and seats assure fast, easy opening and closing, and positive, bubble-tight sealing; the inner metal rings scrape foreign matter from the gate while the o-rings squeegee it clean. Through conduit (6) is provided to assure ideal flow characteristics. Send for bulletin #571.

GROVE PIPELINE VALVES

GROVE VALVE AND REGULATOR COMPANY

a subsidiary of Walworth

6529 HOLLIS STREET • OAKLAND 8, CALIFORNIA

Offices throughout the U.S. and in Western Canada

"They engineered this oil line to a cat's then wrapped it

One of the world's largest pipeline operators chooses the world's toughest tape coating for new Patagonian oil line

A leading international pipeline company recently wrapped over 100 miles of crude oil gathering and transmission line with Polyken No. 960 Extra-Strength Pipeline Roll. The pipe ranges from 2 to 14 inches in diameter.

An Example of Perfection

The new line, which crosses part of the Patagonian plateau of southern Argentina, is an example of perfection in pipeline design. "They engineered it to a cat's whisker," is the way a seasoned pipeliner put it.

In their construction plans, the engineers specifically called for Polyken No. 960 Tape as the protective coating. Seven years of private testing and study had convinced these people that Polyken

whisker"—
with Polyken tape

Using tensioned-spindle equipment, pipe is cleaned and wrapped in one factory-smooth operation. Polyken tape is always ready. No primer, no drying or cooling. No fumes or fire hazard.

delivers the durable, practical protection that a precision-built line needs. Quite a few other major oil and gas companies have come to share this conviction in recent years.

The Man to See

There's a lot to be said for Polyken tape. There's the frequent, substantial saving, the ease of application, the speed and performance, and more. See your Polyken representative or call the Polyken tape coating distributor near you. Or simply write Polyken, 309 West Jackson Blvd., Chicago 6, Ill.

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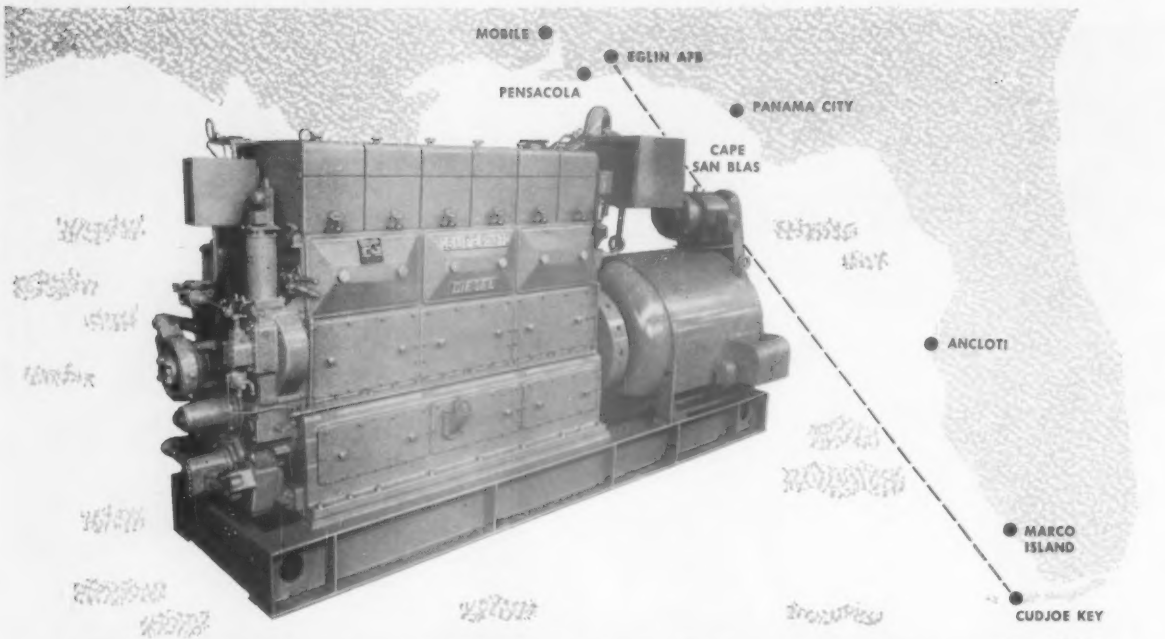
THE WAY

Polyken®

EXPERIENCED IN PROTECTIVE COATINGS

THE KENDALL COMPANY
Polyken Sales Division



WHITE SUPERIOR ENGINES

help "keep score" at one of America's newest missile ranges

The Eglin Gulf Test Range (EGTR), consisting of five missile tracking stations, extends 450 miles from Eglin AFB, Florida down the west coast to Cudjoe Key, 23 miles east of Key West. At Eglin AFB and at three of the five tracking stations, power is supplied by White Superior Model 40-SX-6 engine-generator sets. Each of the five Superior engines on EGTR develops 361 BHP to produce 250 KW. At Cudjoe Key (shown below), two of the Superiors provide power for range safety equipment, trajectory measuring systems, drone control and telemetering devices, from which data is sent back to Eglin.

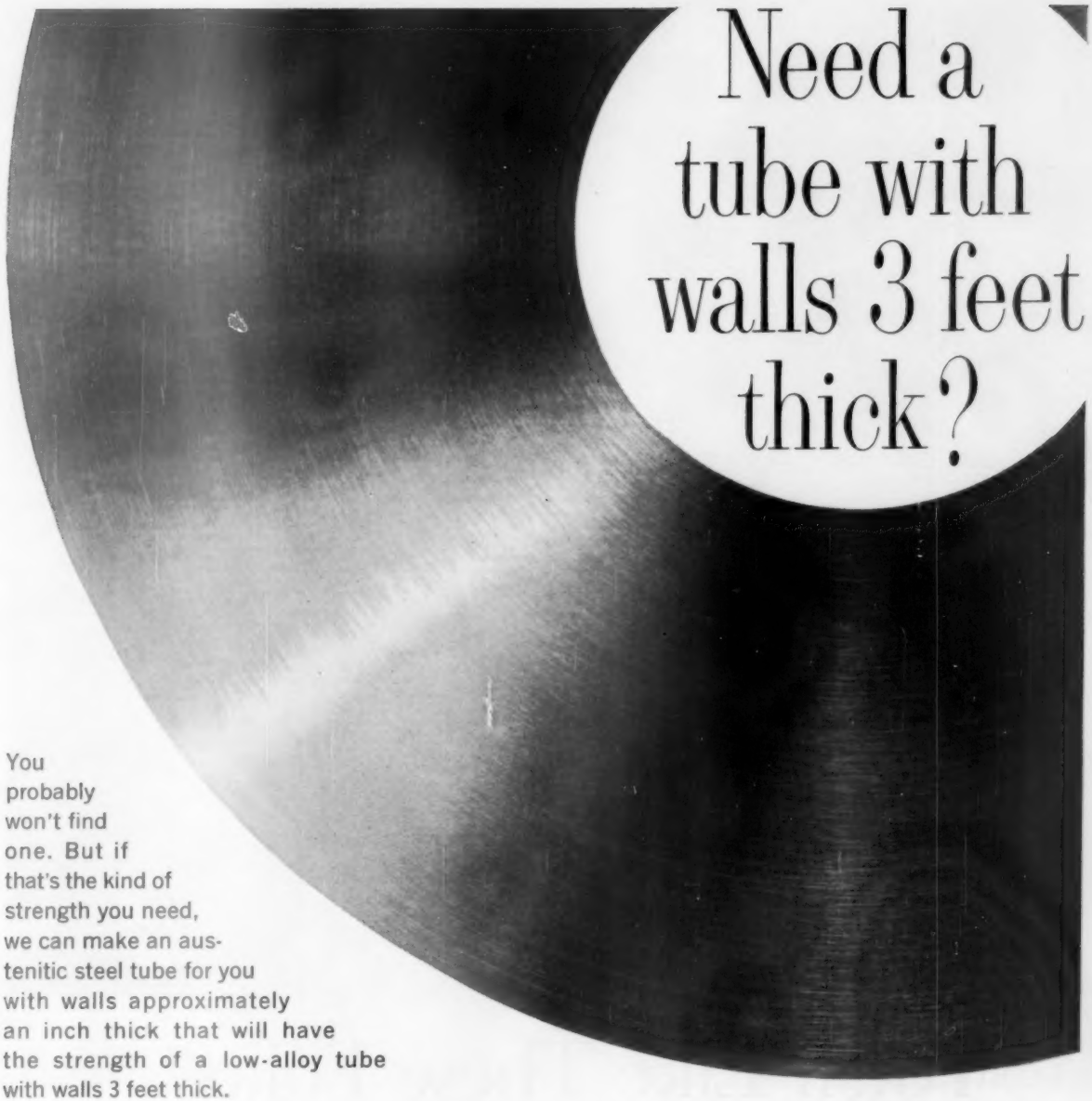
America's newest missile range joins an impressive list of Superior-powered U.S. defense installations, which include the "Texas Towers," portions of "DEW" line and the "SAGE" project, Atlas and other launching stations, and other missile tracking ranges. Government acceptance of White Superior engines for these installations is proof that Superior meets all requirements for rugged dependability, trouble-free maintenance and maximum fuel economy. Superior engines, from 215 to 2150 HP or 150 to 1500 KW, can likewise be custom-engineered to meet your exact requirements, including automatic, unattended or remote controlled operation. Write for complete information today!

Superior ENGINES ATLAS Imperial DIESEL ENGINES White DIESEL

White Diesel

WHITE DIESEL ENGINE DIVISION
THE WHITE MOTOR COMPANY
Plant and General Offices: Springfield, Ohio

U.S. Air Force Photos



Need a tube with walls 3 feet thick?

You probably won't find one. But if that's the kind of strength you need, we can make an austenitic steel tube for you with walls approximately an inch thick that will have the strength of a low-alloy tube with walls 3 feet thick.

That's the kind of tubing we specialize in. We've been solving tough industry problems with Timken® seamless steel tubing for over forty years—in steam generators, oil field equipment, chemical equipment—wherever unusual combinations of heat-, pressure-, or corrosion-resistance are required.

You can get Timken heavy wall seamless steel tubing up to 11″ O.D. and 3¼″ wall. It's available in all the popular low and intermediate alloy steels and austenitic grades—304, 316, 321, 347 and other special analyses.

If you have a difficult tubing problem of any kind, Timken Company metallurgists are eager to work with you and help solve it. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable: "TIMROSCO". Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.

TIMKEN®
***Fine Alloy* STEEL**

TIMKEN ALLOY STEEL AND SEAMLESS STEEL TUBING ARE AVAILABLE FROM STEEL SERVICE CENTERS IN 44 CITIES IN THE UNITED STATES

"You'll Like These Folks"

What's more, you'll respect their judgment. Few banks in America have a staff as broadly experienced in every phase of the oil and gas industry. No matter how complex your operations, you can discuss financing with the men of the First City National Oil Department confident that you are talking to men who *know* the oil business. And oil financing! Come in to see us.

SOON! First City National will be serving you in the newest, best equipped, most modern banking quarters in Texas.

FIRST CITY
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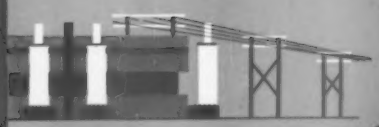
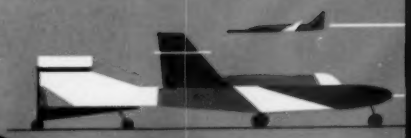
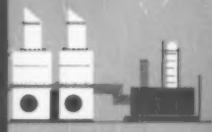
NEW AT BEAIRD



Steam discharge silencers



Jet engine silencers



Heat recovery silencers

MAXIM
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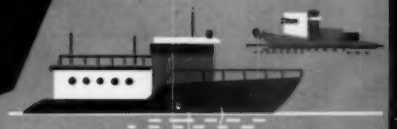
Industrial engine silencers

Ram Jet Silencers



Marine spark arrestor silencers

Heavy equipment silencers

A vigorous new future for...

TIME PROVEN MAXIM SILENCERS

New relief from a noisy mechanical world is symbolized by the combined AMF-Beaird-Maxim emblem. Now in production at Beaird, Maxim Silencers are the latest to join AMF's industrial family of more than 185 fine products for consumers, industry and defense.

Industrial designers, architects and engineers concerned with noise control will find a new depth in research, engineering and manufacturing facility. AMF's five research laboratories and Beaird's steel fabricating experience in the oil, gas and petrochemical industries assures continuous product improvement.

Qualified sound control engineers at AMF-Beaird-Maxim are ready to work with you on every silencer requirement from ocean going steamers to industrial plants . . . jet engines or even home lawnmowers.

Other Beaird products include packaged compressor plants, pressure storage vessels, LP-Gas and NH3 tanks, trailer transport tankers, cast steel fittings and specialized process vessels.

To put this experienced team on your project . . . contact your nearest Maxim Silencer agent or write direct.

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THE J. B. BEAIRD COMPANY, INC.

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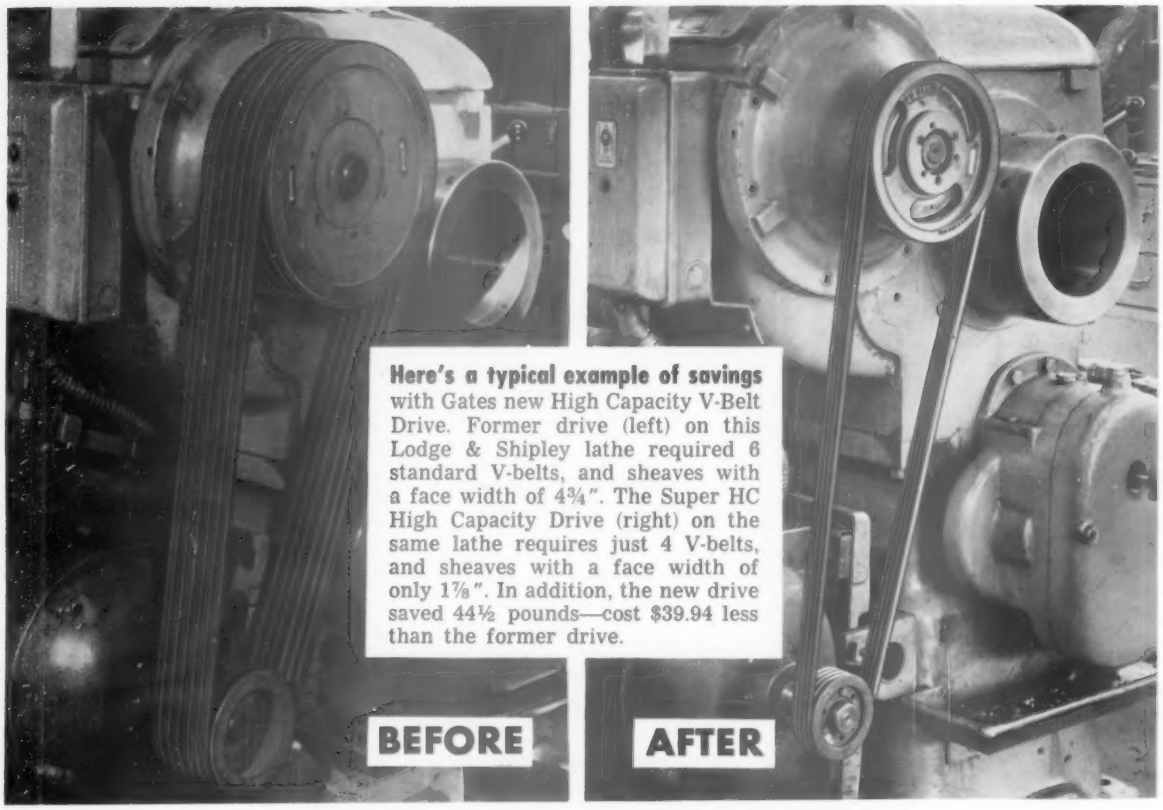


Here's a typical example of savings with Gates new High Capacity V-Belt Drive. Former drive (left) on this Lodge & Shipley lathe required 6 standard V-belts, and sheaves with a face width of 4¾". The Super HC High Capacity Drive (right) on the same lathe requires just 4 V-belts, and sheaves with a face width of only 1⅞". In addition, the new drive saved 44½ pounds—cost $39.94 less than the former drive.

Gates new High Capacity V-Belt Drives

cut costs 2 ways

With V-belt drives on your machine shop equipment, like that shown above, and V-belt drives on your mud pumps in the field, you have 2 ways to make substantial cuts in operating costs.

In *both* cases — in the machine shop and in the field — whenever equipment requires replacement of both sheaves and belts, the higher hp capacity of a Gates Super HC Drive can save space, save weight, save bearing replacement, reduce down-time. You save *money* all along the line!

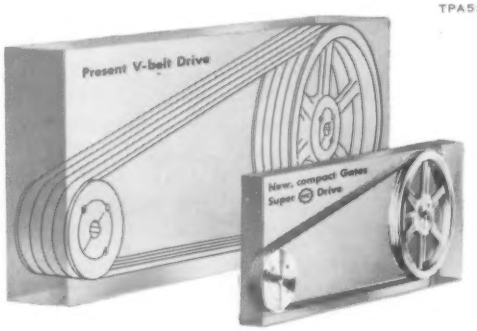
The Gates Rubber Company, Denver, Colorado
Gates Rubber of Canada Ltd., Brantford, Ontario

Gates *World's Largest Maker of V-Belts*

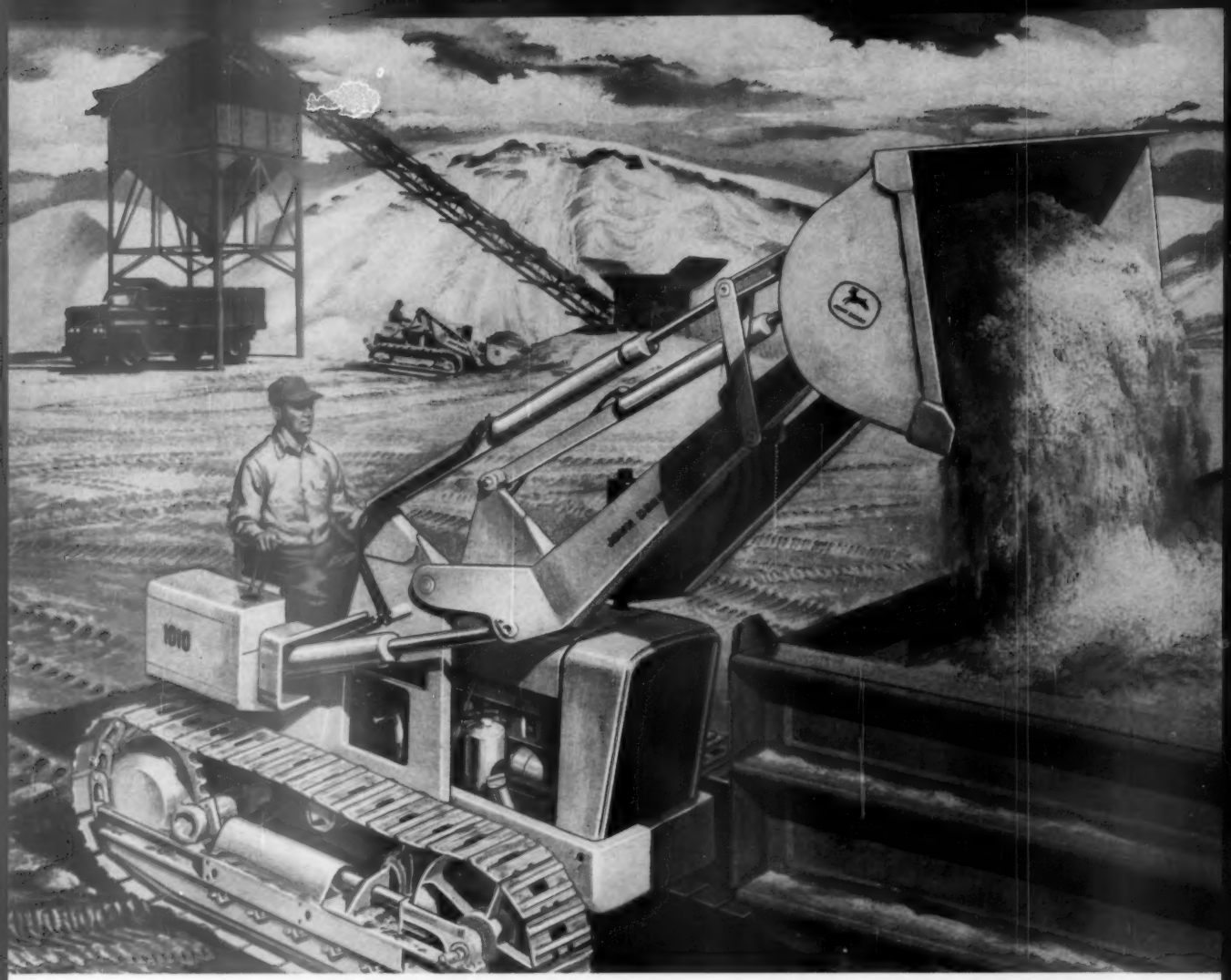
Super HC Stocks and Technical Help Readily Available

You can quickly obtain technical help on drive design and get prompt delivery of Gates new High Capacity V-Belts and Sheaves from your nearby Gates Representative or Oil Field Supply House listed in the Yellow Pages. Ask for handbook: *The Modern Way to Design Multiple V-Belt Drives.*

TPA536A



Gates Super HC HIGH CAPACITY V-Belt Drives — **same hp capacity in smaller "package"**



*Now...***TEN-TEN** *is the word for low-cost earthmoving!*

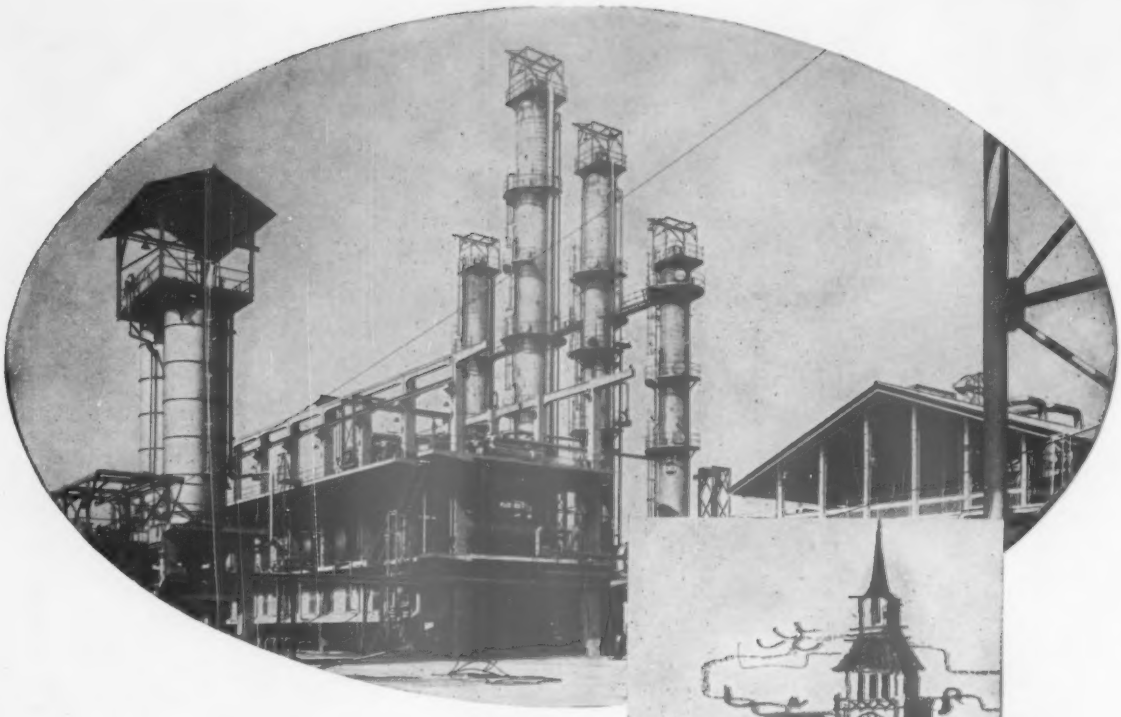
Watch for them! Already, the first members of John Deere's "New Generation of Power" are proving their built-in economy and high work capacity on earthmoving jobs. Powered by all-new John Deere-built 4-cycle, 4-cylinder valve-in-head engines operating at speeds to 2500 rpm, new Ten-Ten Crawlers deliver the versatile performance that loading, dozing, and other construction jobs require. High horsepower per pound plus lugging ability, gives the Ten-Ten plenty of capacity for continued rough work on roads, dams, or building-site preparation. A direction reverser-equipped transmission (optional) provides time-saving maneuverability and handling ease. Gasoline and Diesel power are available, with a wide choice of dozers, backhoes, loaders, and other working equipment.

Get the facts on the new John Deere Ten-Ten Crawler from your John Deere Dealer. He'll provide information, too, on the John Deere Credit Plan and long-term leasing. Check the yellow pages for your nearest dealer.

JOHN DEERE · 3300 RIVER DRIVE · MOLINE · ILLINOIS

JOHN DEERE

LOADERS
BULLDOZERS
BACKHOES
AND
EARTHMOVING
EQUIPMENT



PENNY WISE . . . DOLLAR WISER!

Your process construction dollars buy more . . . when you entrust the job to Procon. Construction-wise Procon purchasing men, engineers and other personnel, go all out to get you the most for your money:

They balance cost against performance . . . hold purchases strictly in line with your budget . . . check and recheck components large and small for materials, tolerances, stresses . . . provide a running account of purchases, a constantly current balance sheet, down to the last penny.

Procon builds plants that perform as intended . . . with materials, parts and components bought the way you'd buy them yourself, if you had the necessary time, facilities and personnel.

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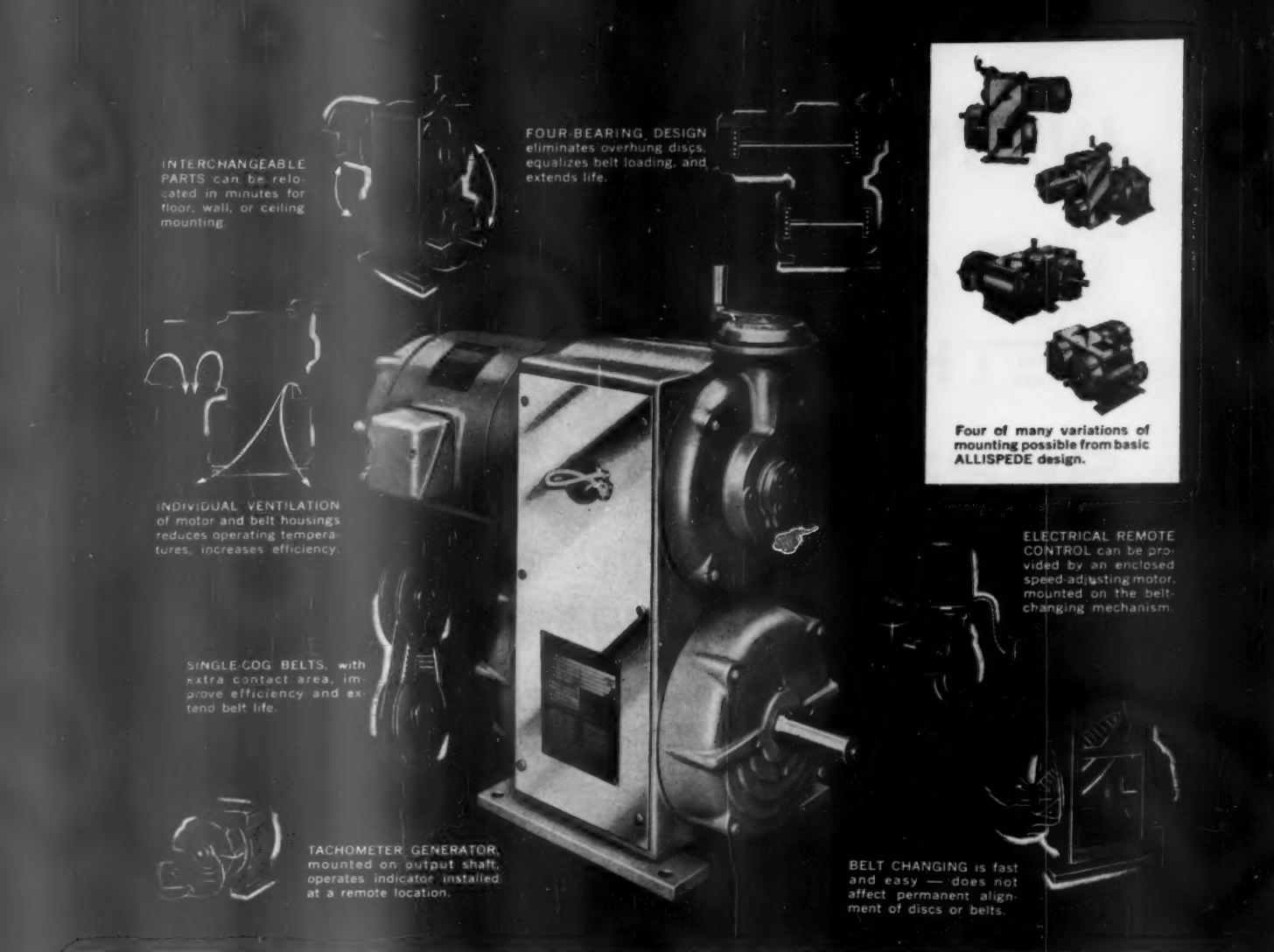
WORLD-WIDE CONSTRUCTION FOR THE PETROLEUM, CHEMICAL AND PETROCHEMICAL INDUSTRIES


INTERCHANGEABLE PARTS can be relocated in minutes for floor, wall, or ceiling mounting.
FOUR-BEARING DESIGN eliminates overhung discs, equalizes belt loading, and extends life.
Four of many variations of mounting possible from basic ALLISPEDE design.
INDIVIDUAL VENTILATION of motor and belt housings reduces operating temperatures, increases efficiency.
ELECTRICAL REMOTE CONTROL can be provided by an enclosed speed-adjusting motor, mounted on the belt-changing mechanism.
SINGLE-COG BELTS, with extra contact area, improve efficiency and extend belt life.
TACHOMETER GENERATOR, mounted on output shaft, operates indicator installed at a remote location.
BELT CHANGING is fast and easy — does not affect permanent alignment of discs or belts.

Let's look at the features of the ALLISPEDE* Drive

New Louis Allis drive offers accurate control—maximum belt life—long-run economy—low-cost versatility—ease of installation

Here's a drive so easily adaptable to changing physical and operating needs that it obsoletes obsolescence. You can relocate components — add or remove attachments and controls — in the field, in minutes.

Its *all-new* design improves performance and efficiency. Inspection, servicing, and belt-changing are a snap. Furthermore, maintenance is almost nil.

As for versatility — there's an Allispede to meet whatever mechanical drive requirement you have. Sizes up to 30 hp, output speeds from 1 to 10,000 rpm, and speed ranges up to 8:1. Motors can be open, drip-proof, enclosed, or explosion-proof—with ventilated or enclosed belt housings — for foot, P-base, C- or D-flange mounting on your machine.

Allispede is available with parallel shaft, or right-angle, integral speed reducers; special shaft extensions; integral magnetic brakes; electrical or mechanical remote control, and other modifications.

Interested? Contact your nearby Louis Allis District Office or write to The Louis Allis Co., 449 East Stewart Street, Milwaukee 1, Wisconsin, for a copy of Bulletin 3600.

*Allispede is a trademark of The Louis Allis Company.

LOUIS ALLIS

MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES

A59-133

INTRODUCING...

The ALL-NEW BETHLEHEM SERIES "60"

A bold new concept in pumping unit design

TRUSS-TYPE STRUCTURE—Base, samson post, and reducer support of the new Series "60" are integrated to form a truss, a design which achieves maximum rigidity and strength per pound of structure.

VERTICALLY-SPLIT REDUCER—Two-piece case, split on vertical center line, permits direct mounting of anti-friction bearings for maximum accuracy of gear, bearing, and shaft alignment.

NEW COUNTERBALANCE CRANKS—New design with multiple filler-weight sections permits great flexibility and top economy in counterbalance selection, and facilitates adjustment from interior servicing platform.

MAXIMUM CAPACITY-TO-WEIGHT RATIO—Truss-type structure, long-radius cranks, and vertically-split reducer provide maximum torque and well-load capacity per unit of weight, thus minimizing transportation and erection costs.

CONVENIENT SERVICING PLATFORM—Centrally located in samson post, the service platform provides a safe, convenient working position for counterbalance and stroke adjustment, and for reducer inspection and servicing.

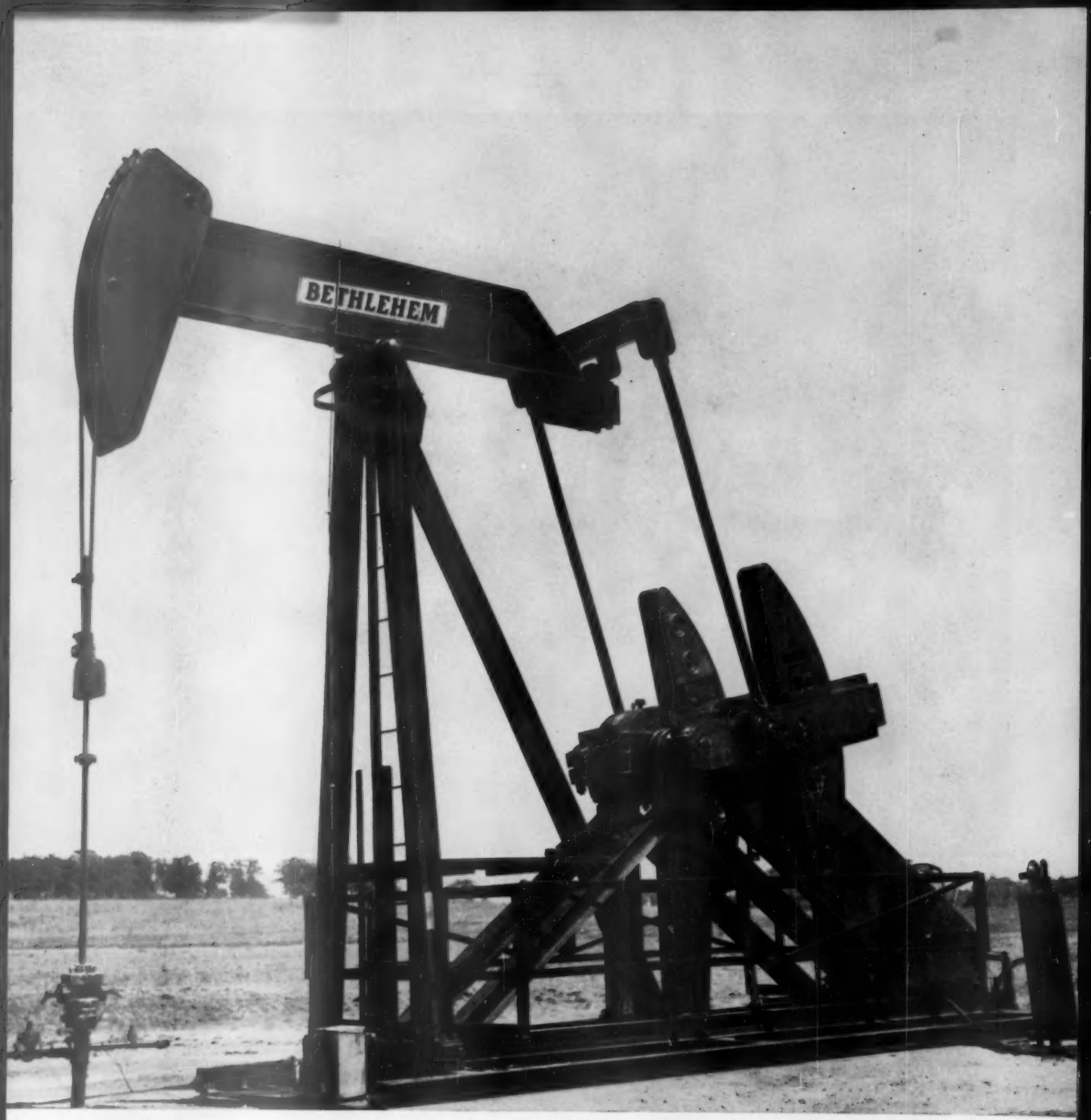
PRE-LUBRICATED BEARINGS—Saddle, tail, and wrist pin bearings are all Bethlube bearings—pre-lubricated during assembly for long, service-free operation.

RUBBER-MOUNTED EQUALIZER—Equalizer and self-positioning tail-bearing are mounted on rubber pads. This, together with hinged upper-pitman connections and self-aligning, roller-bearing wrist pins, provide for perfect alignment.

FOLD-UNDER HORSEHEAD—Hinged horsehead folds under walking beam and returns to pumping position by operation of a latch mechanism from ground level. In well servicing, this safety feature eliminates the need to climb on unit.

MINIMUM CUBAGE—Truss structure of the Series "60" knocks down into single beam sections, permitting compact packaging. This reduces cubage and cuts transportation costs to a minimum.

All these new features make the new Series "60" the best buy on the market. For more information, check with the Bethlehem store in your area. Or write to us direct.



BETHLEHEM STEEL

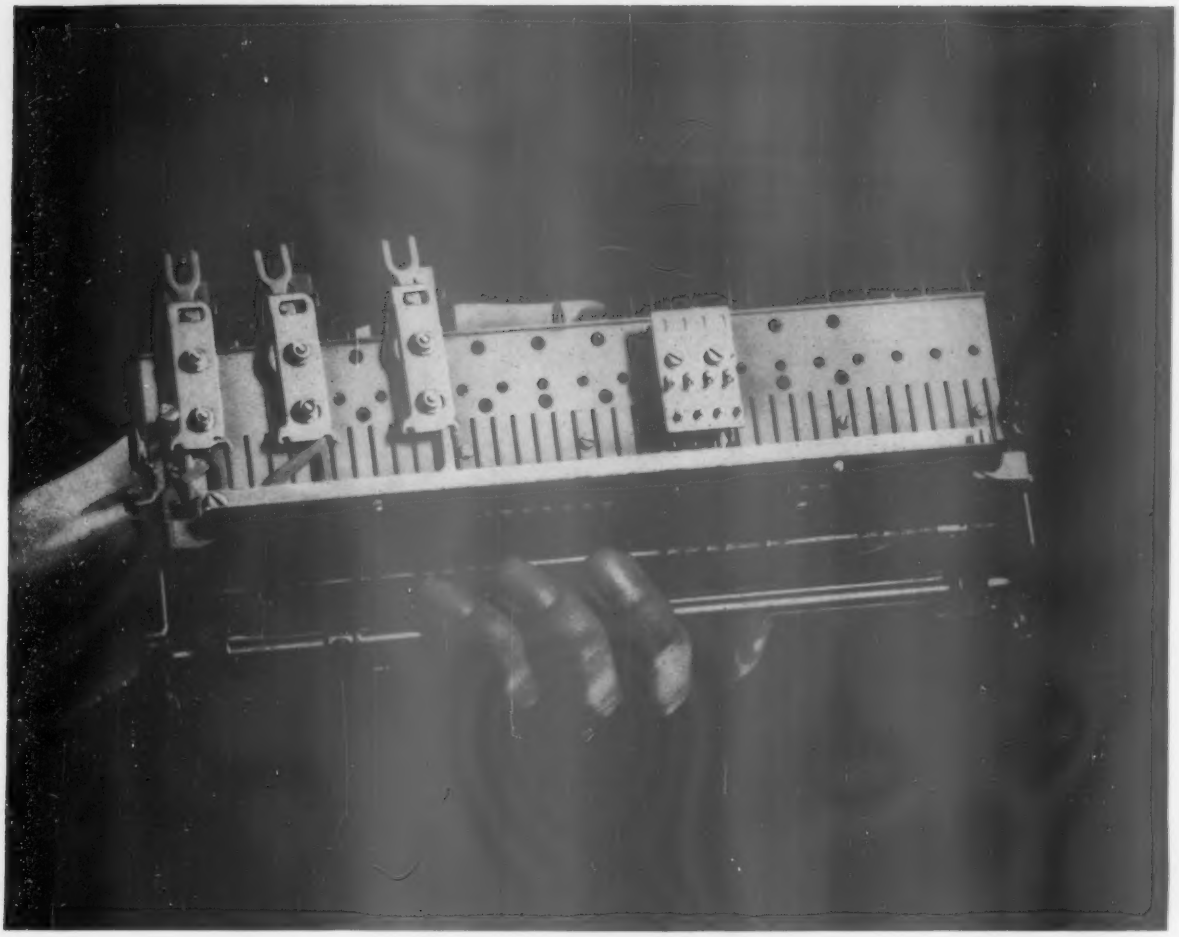
BETHLEHEM STEEL COMPANY • SUPPLY DIVISION

General Offices and Export Dept.: 21 East Second St., Tulsa, Okla.

Canadian Distributor: Bethlehem Supply Company of Canada, Ltd., Calgary, Alberta, Canada

BETHLEHEM STEEL

SUPPLY DIVISION



Stunt Box—your Big Plus with Teletype printers

Built into Teletype Model 28 page printers is a control device called the Stunt Box. The function of this unique component is to provide extra control facilities for both local and remote operations. Thus—in addition to transmitting, receiving and recording messages and data—the page printer can be used for a variety of switching, remote control and selective calling tasks.

The Stunt Box reduces costs by simplifying equipment needs and systems arrangements. It is the Big Plus—the extra value in Teletype Model 28 page printers and automatic send-receive sets.

Teletype Corporation manufactures this equipment for the Bell System and others who require the finest in data communications equipment.

Write for free 20-page brochure, "The Teletype 28 Stunt Box," to Teletype Corporation, Dept. 94K, 5555 Touhy Avenue, Skokie, Illinois.

Typing Tape Punch

Tape Reader

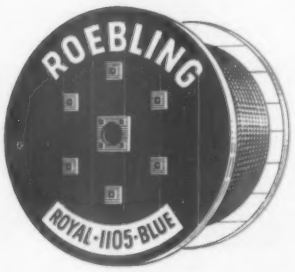
Send-Receive Page Printer

Automatic Send-Receive Set

TELETYPE®
CORPORATION
SUBSIDIARY OF *Western Electric Company* INC.

ROEBLING ROYAL BLUE WIRE ROPE

WE PUT A LOT OF WORK INTO IT—YOU GET A LOT OF WORK OUT OF IT



This happens to be the inside view of Roebling Royal Blue — its core has been removed to show the uniformity and symmetry of the rope structure. You see how concerned we are with internal security.

We have to be. To make sure that Royal Blue will live up to the day-to-day demands made upon it. High stresses and unavoidable overloads, abrasion, fatigue, impact, crushing, sheave pressures and abusive drum-winding, to name the major ones.

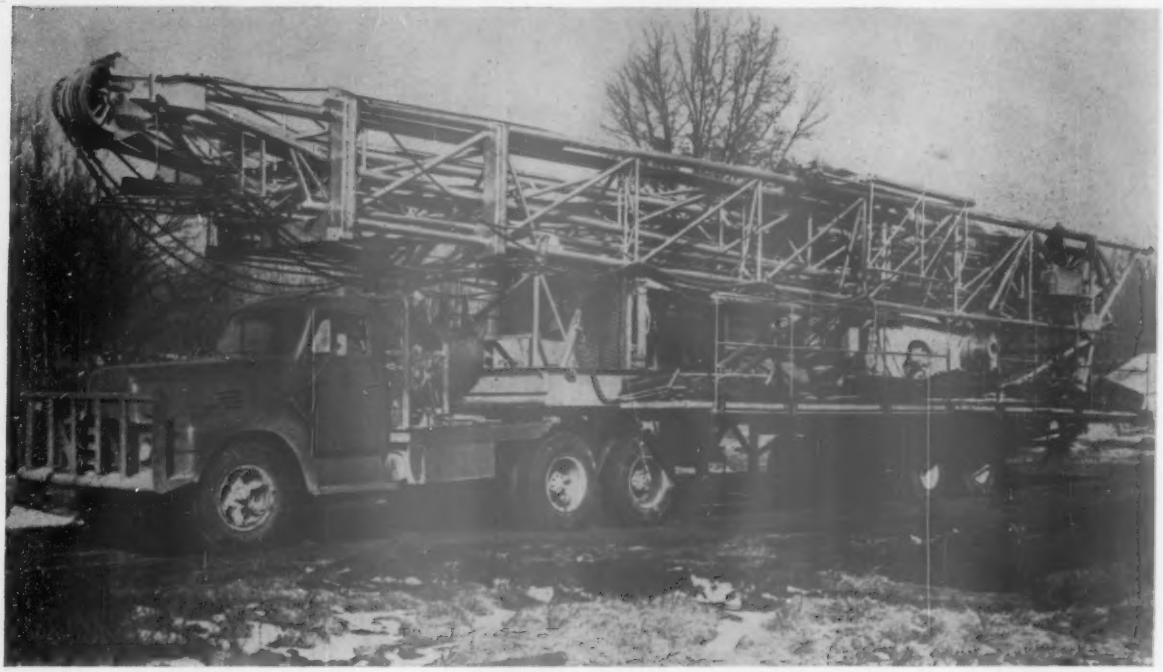
Royal Blue goes through many inspections and tests—both internal and external —before reporting to work. This way we're sure that the rope we build will do what we sell it to do. These quality-control measures are your assurance that Royal Blue is made to save you money — anyway you look at it.

For details about hard-working Royal Blue, ask your wire rope distributor or write Roebling's Wire Rope Division, Trenton 2, New Jersey.

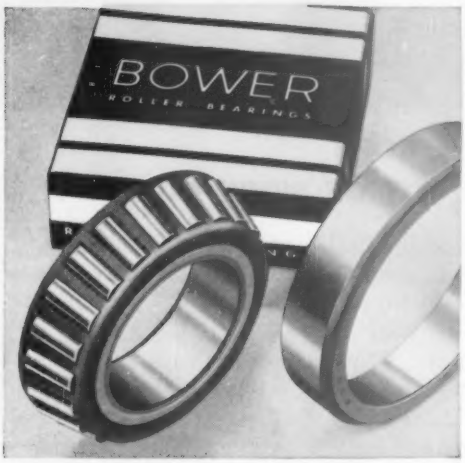
ROEBLING

Branch Offices in Principal Cities • John A. Roebling's Sons Division • The Colorado Fuel and Iron Corporation

Better products, *faster*, from your Bower Distributor:



Bower helps "shoulder" your load to keep rigs rolling



Bower tapered roller bearings, with special Spher-O-Honed rollers, run with less friction to move heavier loads faster

When your operation calls for portable rigs, Bower roller bearings do a better job in transporting big, heavy equipment. Bower long-life quality tapered bearings are made to give long, maintenance-free service for both standard and special equipment.

Bower Spher-O-Honed roller heads are spherically contour ground. They need no run-in. High flanges cut unit pressure—improve alignment. Oil grooves are bigger for positive roller lubrication. All these add up to keep friction and wear at a minimum.

For the finest in tapered or straight roller bearings, see your Bower Bearing Distributor. He gives fast delivery from a complete stock of both types.

BOWER ROLLER BEARINGS

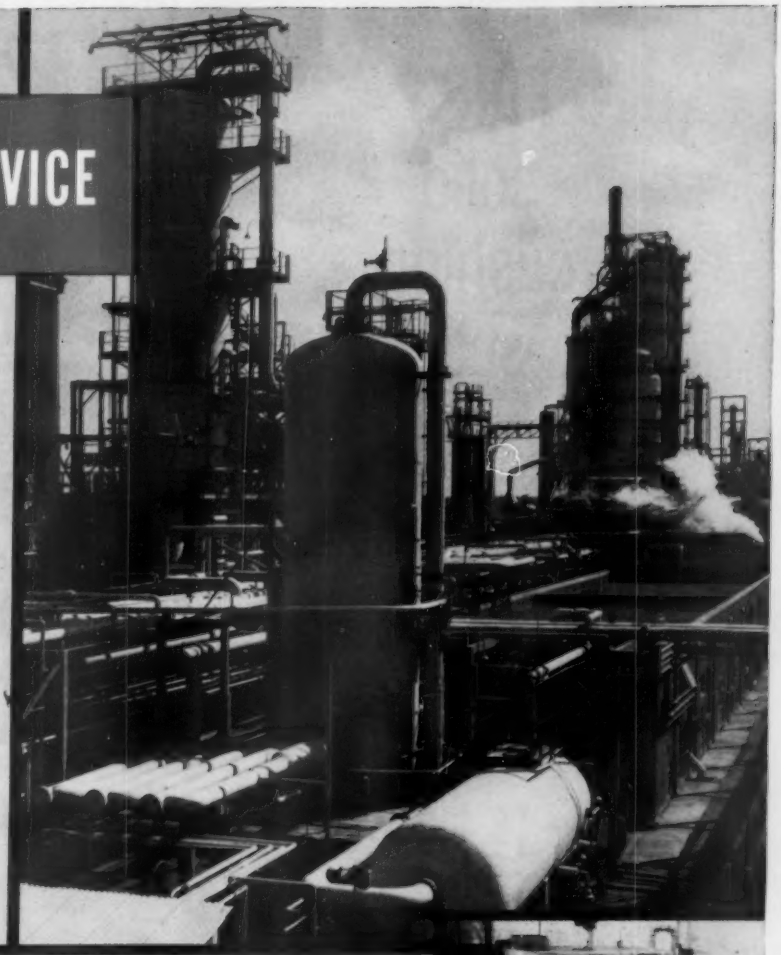
FEDERAL-MOGUL SERVICE

DIVISION OF FEDERAL-MOGUL-BOWER BEARINGS, INC. • DETROIT 13, MICHIGAN

BEARING BOWER ROLLER BEARINGS SERVICE

another
TRETOLITE SERVICE
report

KONTOL
Corrosion Inhibitor permits low pH operation in refinery's crude unit overhead system



OHIO OIL COMPANY GETS EFFECTIVE CORROSION CONTROL, BETTER PRODUCT QUALITY AT REDUCED COST

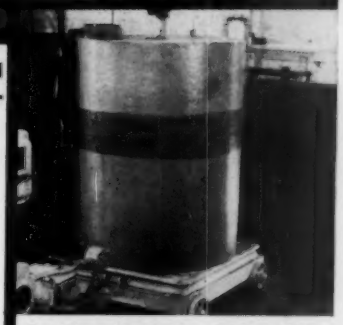
An outstanding performance record compiled over a five-year period in Ohio's refinery at Robinson, Illinois, proves the feasibility of low pH operation augmented by KONTOL* Corrosion Inhibitors.

Prior to inauguration of the low pH-KONTOL program, a high (7.5) pH operation on overhead receiver waters was fouling equipment. Heavy sludge deposits were accumulating ahead of exchanger baffles, and ammonia was contaminating hydrocarbon streams. These troubles limited the refinery to short runs at decreased capacity. *In addition, serious corrosion problems resulted in extensive equipment replacement and repairs after only nine months of operation.*

By changing to a low (4.0-4.5) pH and injecting KONTOL Corrosion Inhibitor at a rate of 10-15 ppm, Ohio has stopped sludging and greatly lowered ammonia contamination. Equipment has been kept clean, reducing maintenance costs and permitting longer runs at increased charge rates. Turnaround inspection has been lengthened to 18-month intervals. *No equipment failures due to corrosion occurred during this five-year period.*

Low pH operation supported by KONTOL corrosion control might offer important advantages for your refining facilities. Ask the Man in the Red Car to explain this program, or write . . .

*Registered trademark, Petrolite Corporation



Facilities such as this one for Kontol injection at various points are part of over-all corrosion control program at Ohio Oil Company's Robinson, Ill., refinery.

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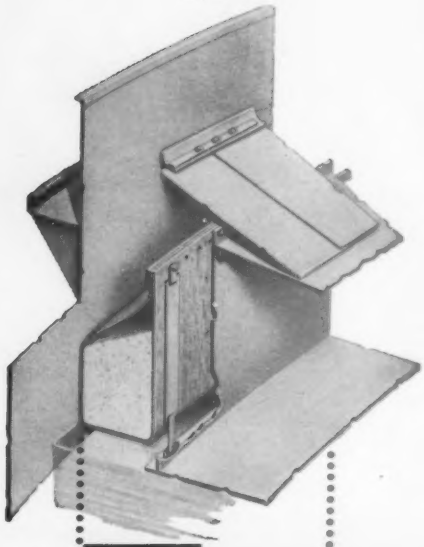
KR-60-1

FIRST solid cushion seal



When General American developed EverSeal, first solid cushion seal for floating roofs, we wanted a seal that would have these advantages:

1. Simplicity of design, no moving parts, nothing to corrode
2. Permanent, indestructible sealing qualities—no gas or liquid to leak
3. Complete protection of coated tank walls from scuffing or gouging
4. A tough, pliable envelope that would withstand abrasion; ride without damage over projections on the shell
5. Ease of repair or replacement, without taking tank out of service
6. Maximum protection against evaporation loss
7. Full protection of oxygen-sensitive stocks
8. No build-up of vapors in the seal area

EverSeal is the *first* solid cushion seal to meet *all* these requirements. It is made of trapezoidal urethane foam cushions enclosed in a tough, scuff-proof envelope of Buna "N" synthetic rubber and polyvinyl chloride plastic.

EverSeal is almost impossible to damage, always provides a safe and complete seal for every floating roof.

Write or phone your nearest General American office for complete information.

It pays to plan with General American.

EverSeal*

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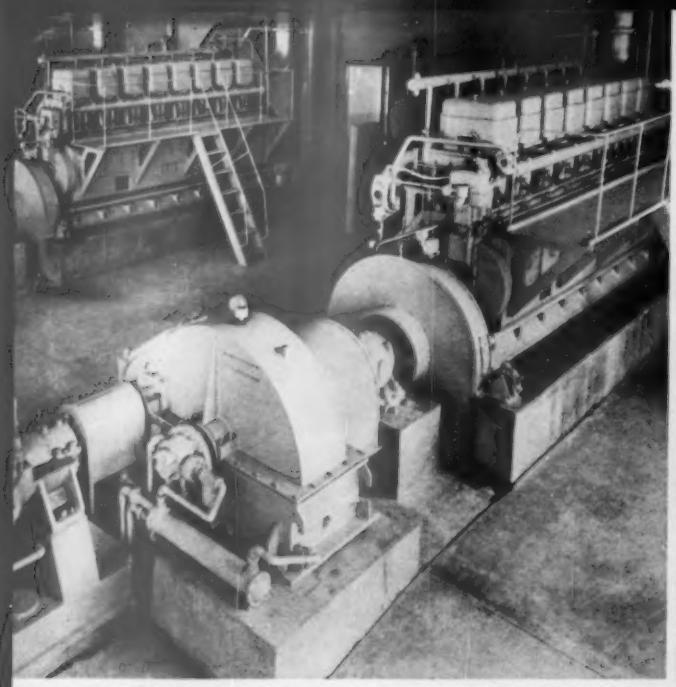

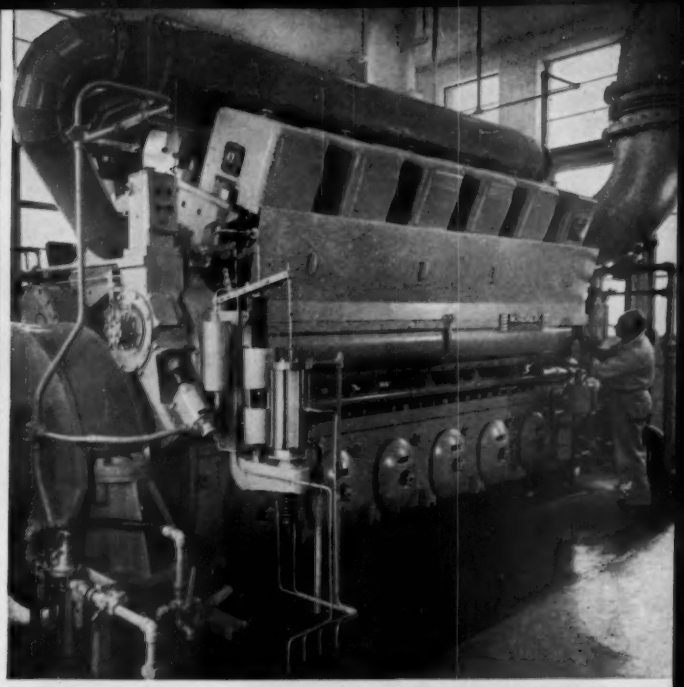

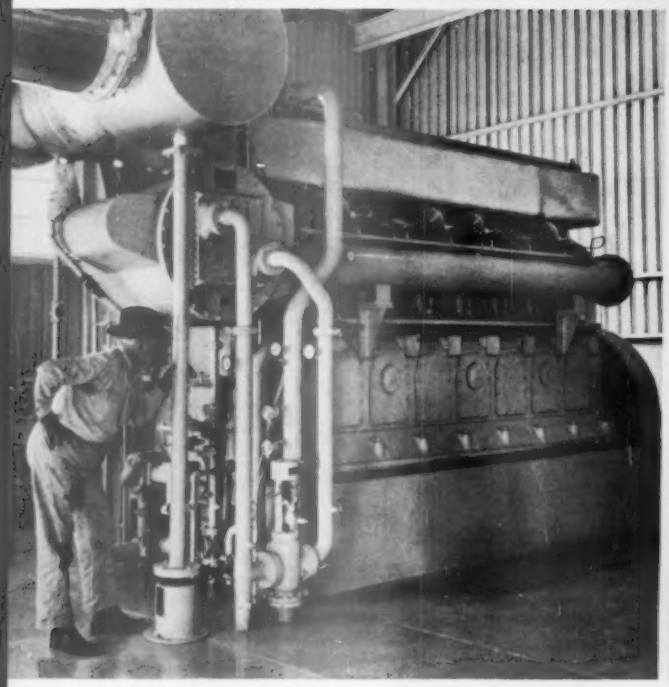

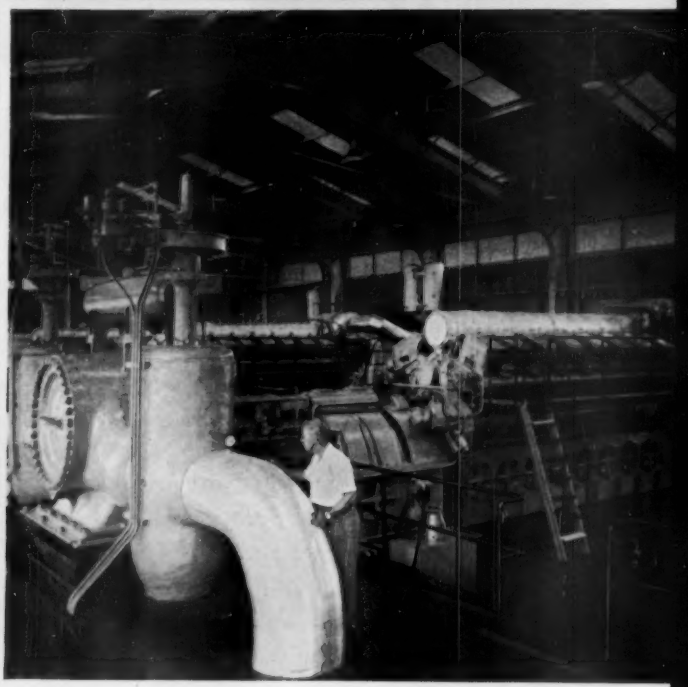

Pipe line engines by Nordberg

Nordberg engines are a sound investment in long term pipe line power.
Consult Nordberg on your crude, products or gas pipe line programs.

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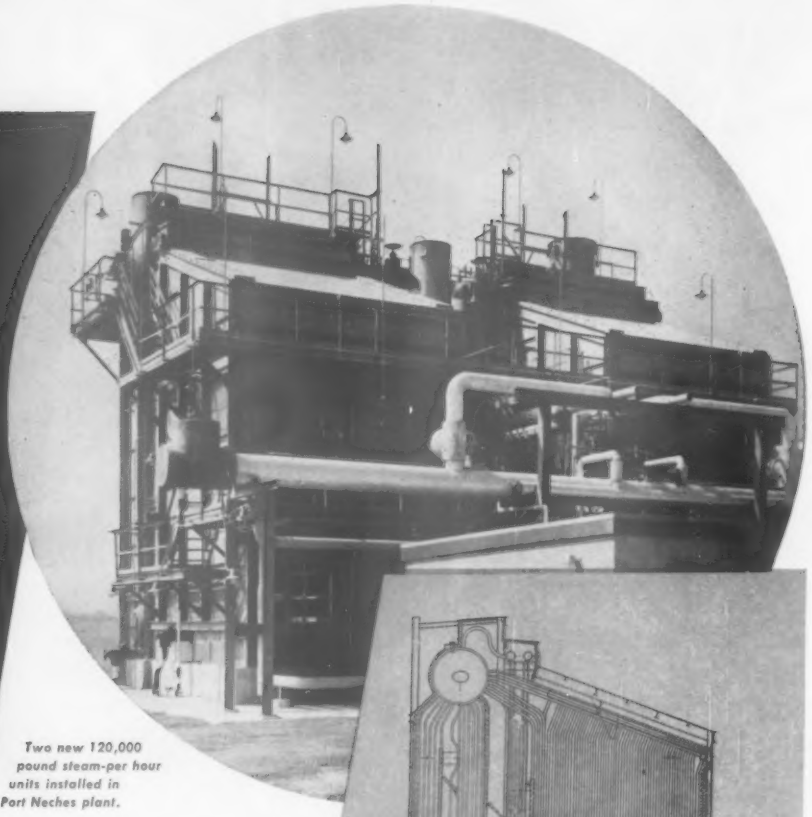
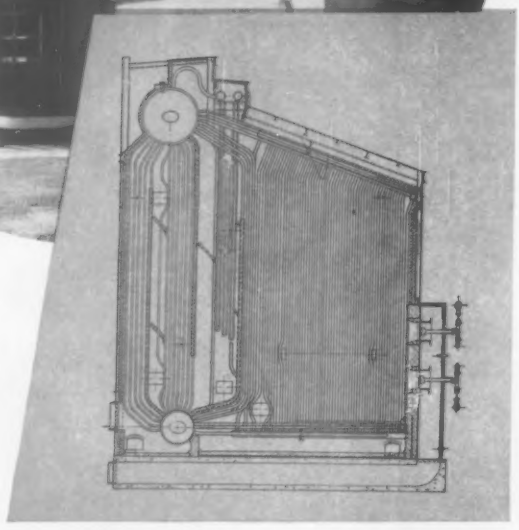
Steam for Jefferson Chemical by Vogt



Two new 120,000 pound steam-per hour units installed in Port Neches plant.



The needed additional power and process steam capacity for Jefferson Chemical's expanded Port Neches plant is furnished by the two Vogt boilers pictured here, each with a capacity of 120,000 pounds per hour. The boilers are designed for 675 lbs. pressure to operate at 625 lbs. pressure and 769°F. total temperature. The furnaces are equipped with gas burners and have water cooled front and side walls.

Bulletins describing Vogt boiler installations in a variety of industrial plants for power, processing and heating are available on request.

Installation by C. F. Braun and Co., Engineers.

For Custom Installation Bulletin VF-VS-2 • Package Unit Bulletin PSG-3, address Dept. 24A-BO.

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STEAM GENERATORS

Vogt

the best off-the-road equipment . . .

is off-the-ground equipment

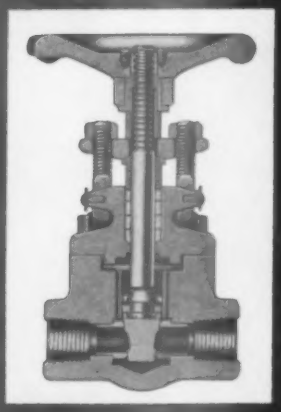
Here's what we mean: The Pipeline Welding and Construction Company of Oswego, Kansas is building a cross-country pipeline in rural Minnesota. Since the pipe is buoyant and is being laid in swamps, marshes and lakes, it has to be anchored in place by 3,000-pound concrete jackets. It used to take 20 men with tools plus 2 sideboom tractors plus 1 dragline boom tractor plus flotation gear plus 10 solid hours of labor to lay 20 of these 3,000-pound concrete jackets. That was before a Sikorsky S-58 helicopter was put to the task. Now it takes just 4 men less than an hour to do the same work. Peewee Vaughn, project foreman, says, "I'll never again do a cross-country job like this without a helicopter." Pilot John Sharbrough says, "The Sikorsky helicopter is the only helicopter that could possibly do this job, and it's a machine that will do everything the manufacturer says it will do." Think about your own business for a moment. There might be a place for Sikorsky helicopters to open up a whole new area of savings. We'll be glad to discuss it with you.

A New World of Mobility by
SIKORSKY AIRCRAFT
Stratford, Connecticut
A Division of United Aircraft Corporation

FORGED STEEL VALVES

Recommended for:

- REFINERIES, PETRO-CHEMICAL, POWER, PROCESS INDUSTRIES
- GAUGE, INSTRUMENT, METER LINE SERVICE



"R-P&C Forged Steel Valves are designed for streamlined safety"

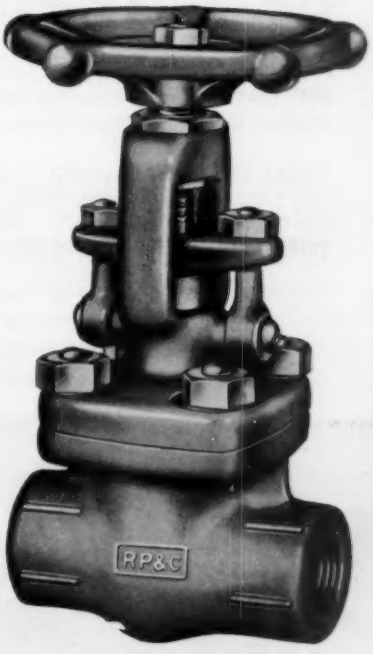
" 'Streamlined safety' is the R-P&C way of saying that this Forged Steel Valve is now lower in weight yet higher in safety than ever before. Thanks to an improved design worked out with leading material specification engineers, all unnecessary bulk and weight in R-P&C Forged Steel Valves have been eliminated. **Ample metal sections** throughout the valve body still give it the highest possible safety factor."

Other new design features like these add up to a long life of trouble-free service:

- **Spiral wound gasket in bolted bonnet joint**
- **Careful heat treatment of parts for strength and wear**
- **Unique stem design to protect stuffing box packing**
- **High quality materials to prevent corrosion**
- **Precision manufacture with exacting standards**

In addition to these Forged Steel Gate and/or Globe Valves, R-P&C distributors offer users in all industries a complete line of R-P&C gate, globe and angle valves in all standard materials: electric furnace iron, bronze, bar stock, cast steel... plus many specialties.

Contact your R-P&C distributor



R-P&C VALVES

ACCO

R-P&C Valve Division, American Chain & Cable Company, Inc.

Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

BARRELS PUMPED: 1,504,320
TOTAL MAINTENANCE COST: $73.89

CASE HISTORY

PUMP: Gaso Fig. 3466 Horizontal Triple Plunger Pump placed in salt water service June 1, 1957, operating at 225 RPM against 900 PSI.

PERFORMANCE: During the period of this report, the pump discharged a total of 1,504,320 barrels of salt water.

TOTAL SERVICE REQUIRED: Repacking of plungers after 7½, 15 and 27½ months' service.

TOTAL MAINTENANCE COST: $73.89—less than 5¢ per 1000 barrels pumped.

In water flooding as in pipe line service, Gaso performance speaks for itself, proves over and over that Gasos are the logical choice of operators who buy on the basis of maximum performance at minimum cost. May we send you our 1960-61 catalog?

More Dramatic Proof of Gaso Performance in Water Flooding Service!

GASO PUMPS
for every oil industry need

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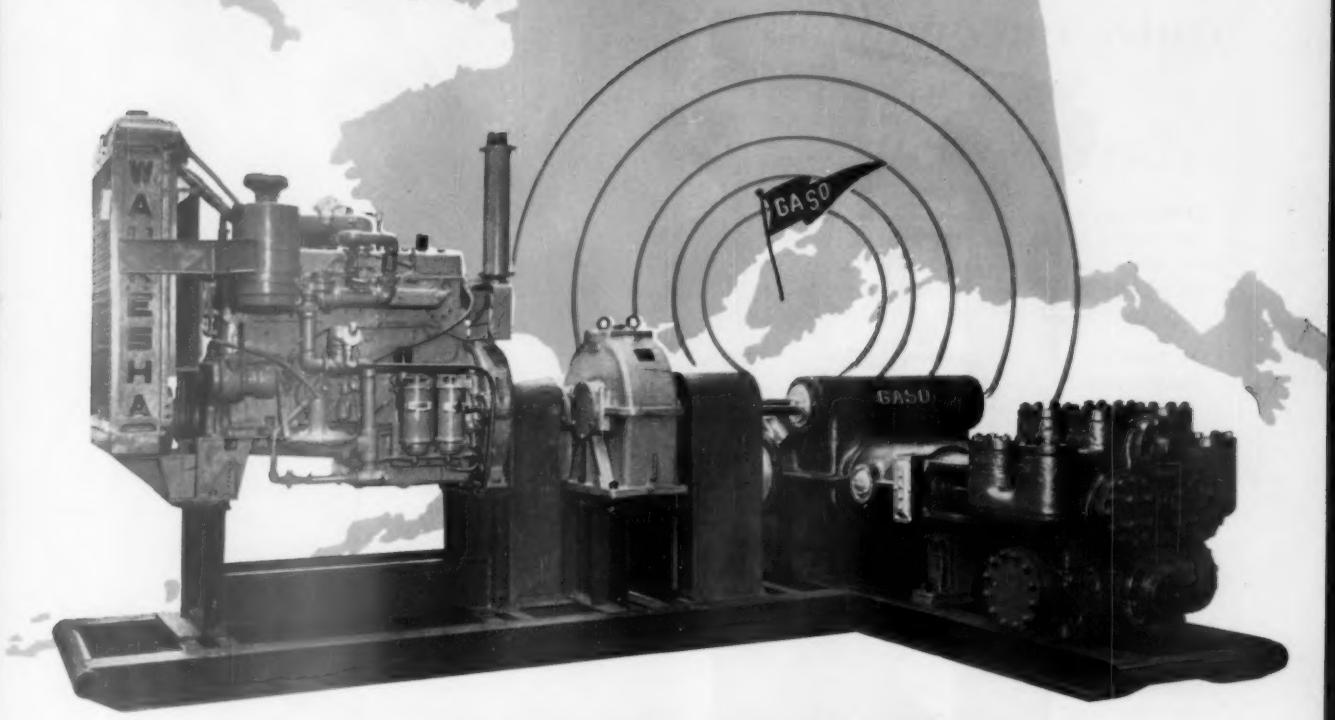

GASO PUMPS BRING GASO PERFORMANCE TO THE 49TH STATE

The photograph shows one of two Gaso Pumping Units delivered to the Kenai Pipe Line Company. The assembly consists of a Gaso Figure 2651, 5½"x12" Horizontal Duplex Piston Power Pump direct connected through a Lufkin 4.25 to 1 gear reducer to a Model 6-WAKBU Waukesha Oilfield Power Unit.

Normal operation calls for 435 barrels of crude oil per hour—10,440 barrels per day—at 500 pounds discharge. Under emergency conditions the pump will deliver the fluid at 950 pounds discharge.

The world-wide preference for Gaso Pumps stems from performance that speaks a language all pipe line engineers understand—a language of completely dependable service for longer periods of time, with less maintenance, all adding up to greater returns on the pumping investment.

SEND FOR OUR 1960-61 CATALOG

GASO PUMPS
for every oil industry need

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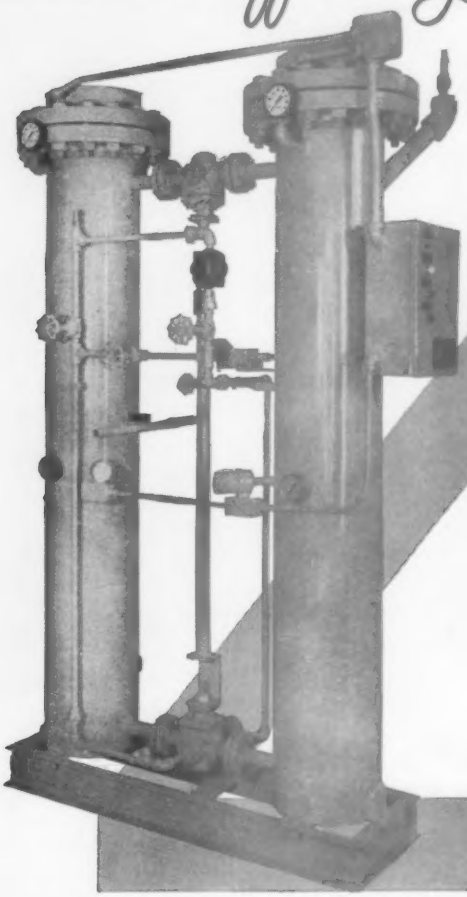
KEMP ORIAD DESICCANT DRYERS

cut costs, add efficiency 4 ways!



1 Complete reactivation

An exclusive 3-zone embedded heater design gives every Kemp Oriad Desiccant Dryer extra drying power *economically* (effective distribution of heating elements assures high heat transfer efficiency). The most complete reactivation results... providing maximum desiccant capacity, minimum dewpoint performance.

2 Full automatic operation

Set the program timer and everything is regulated automatically. Gases are dried with the least pressure loss, lowest maintenance and operating costs. Your choice of manual or semi-automatic systems, too.

3 Accurate temperature control

Thermostatic control conserves heat input... maintains ideal temperatures for highest operating efficiency in drying instrument air, process air and gases to the lowest dew point, eliminating condensation or freeze-up, and other applications.

4 No moving parts

There are no blowers, fans or motors to create maintenance problems, rising operating costs. Unit comes fully assembled, ready to install and operate. Write today for Bulletin D-103, or contact your Kemp man, listed in the *Chemical Engineering Catalog*.

It always pays to come to

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THE C. M. KEMP MANUFACTURING COMPANY
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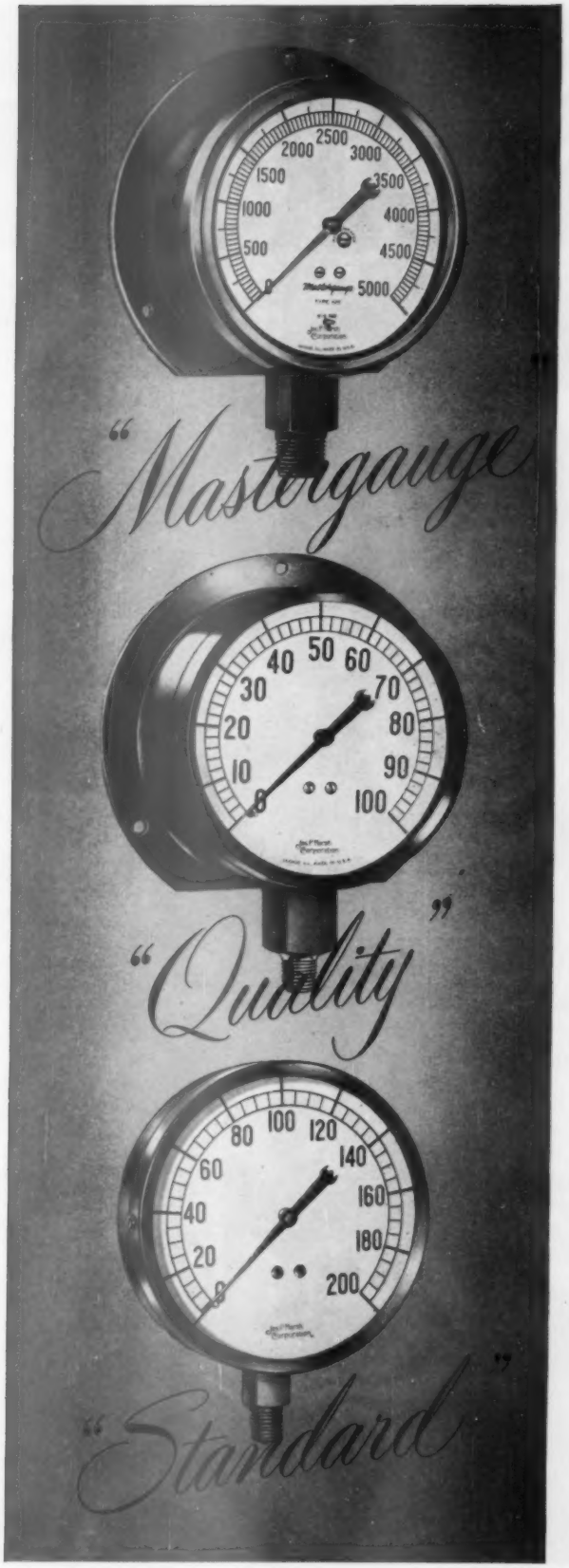

What pressure gauge for your particular need?

The clear-cut economical answer to your specific gauge problem is right here in the Marsh line. It is here because the Marsh line contains the world's most complete range of gauges in the three broad brackets of gauge applications.

THE "MASTERGAUGE" GROUP...for those extreme services that demand the ultimate in gauge precision, accuracy and stamina.

THE "QUALITY" GROUP...also for tough conditions, but less severe than the conditions served by the "Mastergauge" Group.

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While these three brackets run a wide gamut of prices, the difference between them is not so much a matter of *grade* as a matter of *kind* and *purpose*. All gauges in all groups reflect Marsh precision and quality. Collectively they cover practically every conceivable gauge requirement.

The answer is in the catalog... but if you have a special problem let our engineering department work with you to select the most efficient, most economical solution to your problem.

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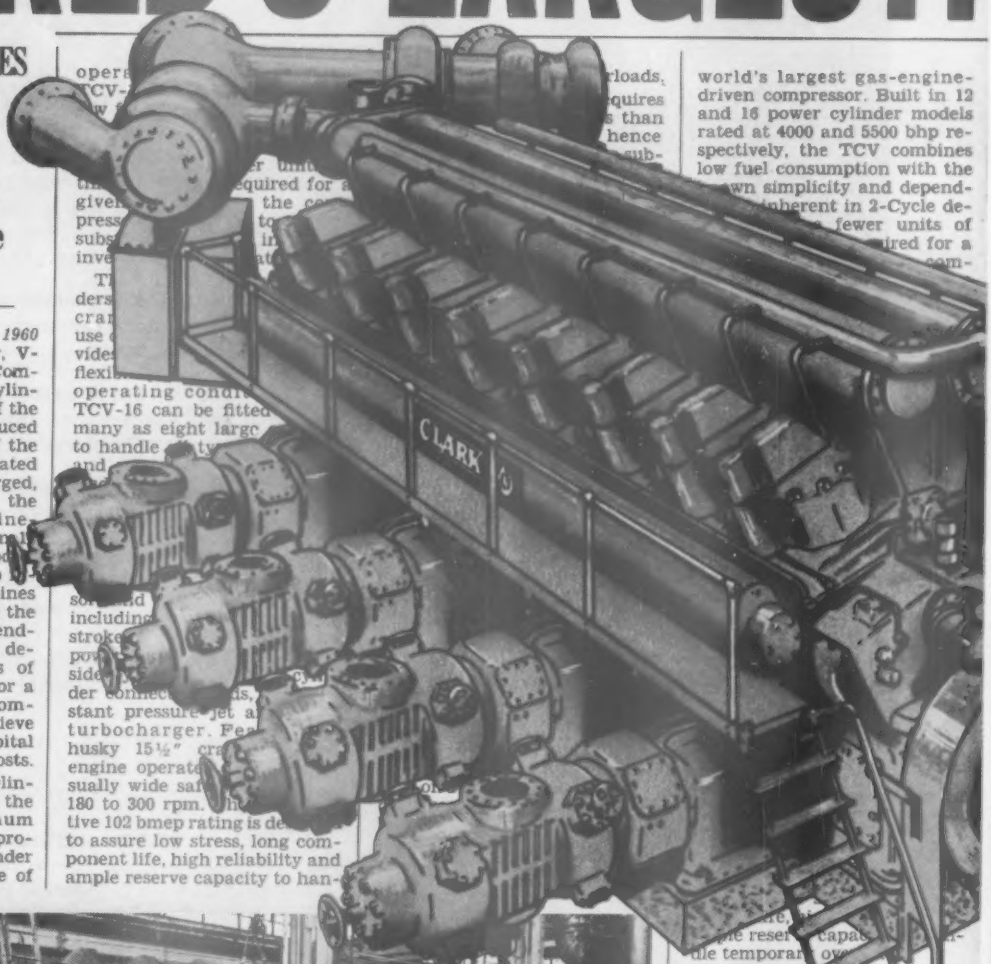
"THE STANDARD OF ACCURACY"

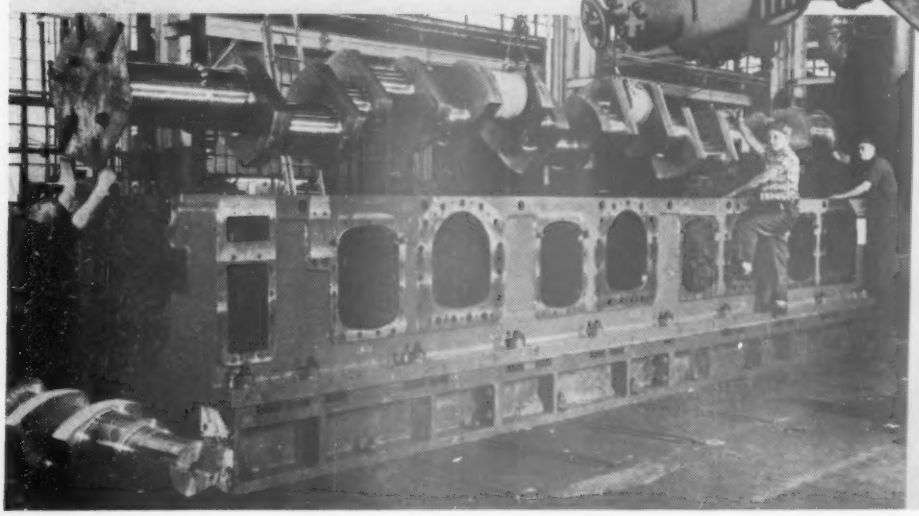
WORLD'S LARGEST!

CLARK INTRODUCES 5500 bhp V-TYPE GAS-ENGINE-COMPRESSOR—world's largest for pipeline gas transmission

Olean, New York—July 27, 1960—A new, high horsepower, V-Type Gas-Engine-Driven Compressor with compressor cylinders on one or both sides of the crankcase has been introduced by Clark Bros. Co., one of the Dresser Industries. Designated Model TCV, this turbocharged, 2-Cycle machine will be the world's largest gas-engine-driven compressor. Built in 12 and 16 power cylinder models rated at 4000 and 5500 bhp respectively, the TCV combines low fuel consumption with the known simplicity and dependability inherent in 2-Cycle design. Because fewer units of this size will be required for a given application, the compressor is designed to achieve substantial savings in capital investment and operating costs.

The use of compressor cylinders on one or both sides of the crankcase makes maximum use of available space and provides unprecedented cylinder flexibility for a wide range of





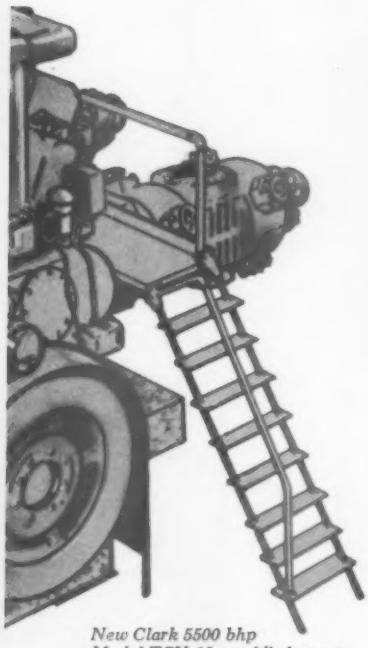
Crankshaft being lowered into lower crankcase of new Clark Model TCV, 5500 bhp Gas-Engine-Driven Compressor. Note huge proportions of both case and shaft forging.

world's largest gas-engine-driven compressor. Built in 12 and 16 power cylinder models rated at 4000 and 5500 bhp respectively, the TCV combines low fuel consumption with the known simplicity and dependability inherent in 2-Cycle design. Because fewer units of this size will be required for a given application, the compressor is designed to achieve substantial savings in capital investment and operating costs.

The use of compressor cylinders on one or both sides of the crankcase makes maximum use of available space and provides unprecedented cylinder flexibility for a wide range of operating conditions. For example, the TCV-16 can be fitted with as many as eight large cylinders to handle a high quantity of gas, including a long stroke, high power, single-side-rod cylinder connected to a constant pressure-jet assisted turbocharger. Featuring a husky 15½" crankpin, the engine operates at unusually wide safe speeds, 180 to 300 rpm. The conservative 102 bmep rating is designed to assure low stress, long component life, high reliability and ample reserve capacity to handle temporary overloads.

Clark 2-Cycle design requires substantially fewer moving parts than other type machines, hence there are less components subject to wear and replacement. Since every downstroke is a power stroke, there is twice as many power impulses over which to spread the load. As a result, the TCV is well suited to variable-speed, variable-load applications and performs smoothly at substantial speed reductions when torque is held constant.

SAVINGS IN CAPITAL INVESTMENT AND OPERATING COST OFFERED BY NEW CLARK 5500 bhp GAS-ENGINE-COMPRESSOR



New Clark 5500 bhp Model TCV-16, world's largest Gas-Engine-Compressor. Also available in 12 power cylinder Model TCV-12, delivering 4000 bhp.

Many features combine in the new Clark TCV-16 Gas-Engine-Driven Compressor – world's largest integral unit – to help reduce investment and operating costs of pipeline gas transmission. Available in 12 and 16 power cylinder models, the TCV design offers these cost-cutting advantages:

- Highest horsepower – fewer units required
- 2-cycle simplicity – maximum dependability
- Pure turbocharging – bonus power and best overall fuel economy
- Wide, safe speed range – 180-300 rpm at constant torque
- Low bmep – long life and high overload capacity
- Less costly to automate – fewer units, fewer controls

The TCV-16 can accommodate as many as eight *large* compressor cylinders and still provide easy accessibility. Maximum use of space and unprecedented flexibility to meet a wide range of operating conditions are assured by the new design, in which compressor cylinders can be located on one or both sides of the crankcase. These units can handle all types of pipeline and process requirements including multi-service applications where several gas streams are compressed by one machine. Major economies result from the use of fewer, more powerful units for a given application.

Many features of the new Clark TCV Gas-Engine-Driven Compressors have been thoroughly proved in Clark TLA Compressors and in the Clark TPV Gas Engines. Find out how these savings can be yours – what the TCV-12 and TCV-16 mean to you in terms of profit. Consult your Clark representative or write today for Bulletin No. 188.

CLARK BROS. CO., OLEAN, N.Y.

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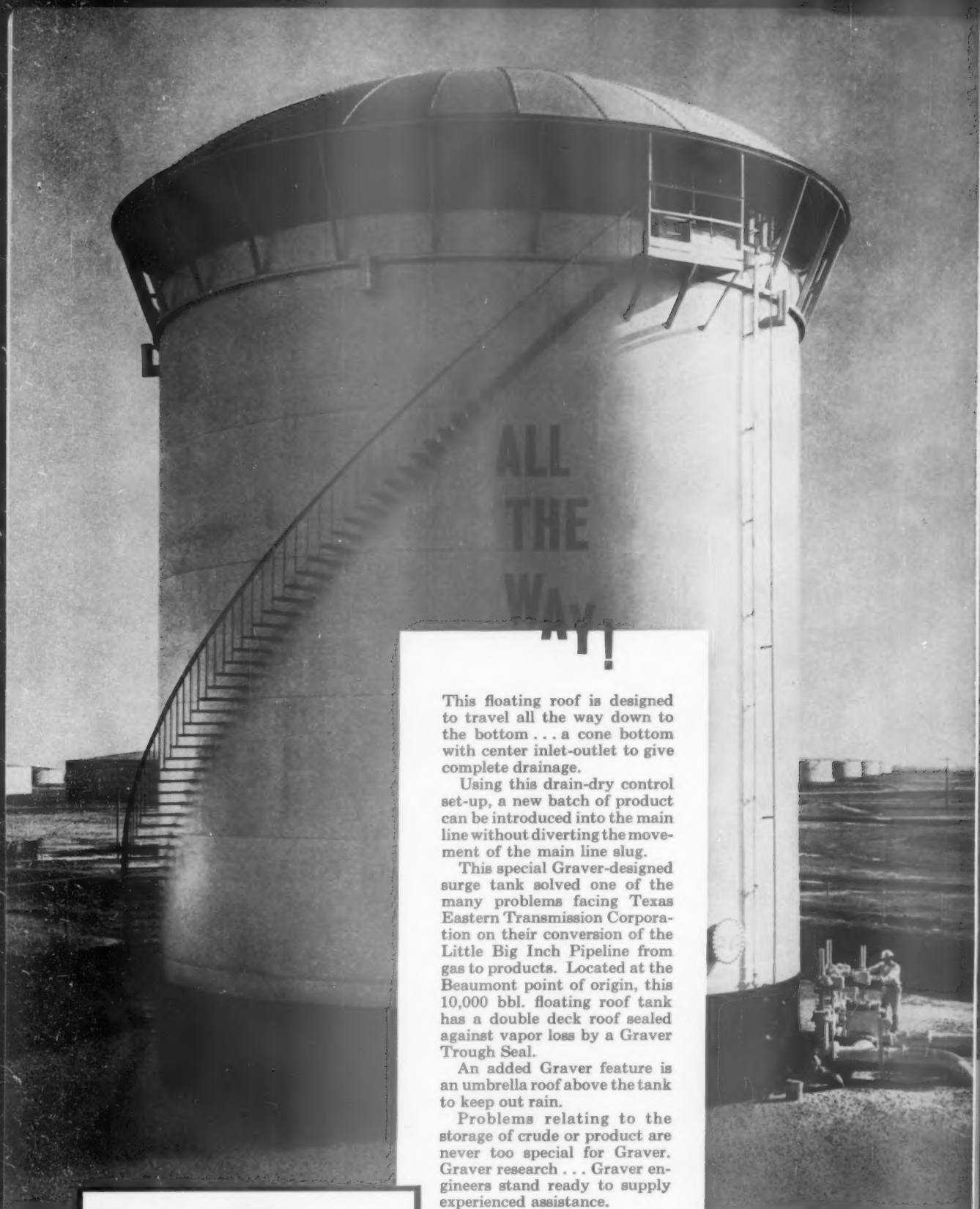

This floating roof is designed to travel all the way down to the bottom . . . a cone bottom with center inlet-outlet to give complete drainage.

Using this drain-dry control set-up, a new batch of product can be introduced into the main line without diverting the movement of the main line slug.

This special Graver-designed surge tank solved one of the many problems facing Texas Eastern Transmission Corporation on their conversion of the Little Big Inch Pipeline from gas to products. Located at the Beaumont point of origin, this 10,000 bbl. floating roof tank has a double deck roof sealed against vapor loss by a Graver Trough Seal.

An added Graver feature is an umbrella roof above the tank to keep out rain.

Problems relating to the storage of crude or product are never too special for Graver. Graver research . . . Graver engineers stand ready to supply experienced assistance.

Graver

DIVISION—UNION TANK CAR COMPANY

Graver Tank & Mfg. Co.

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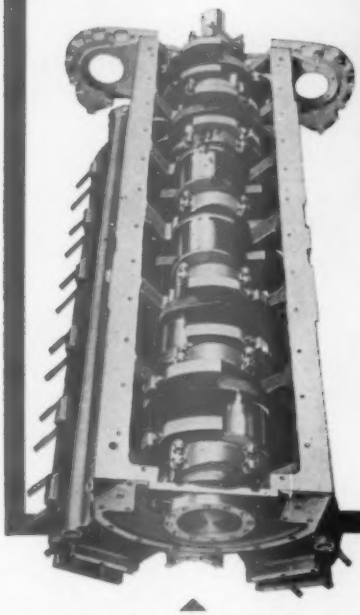
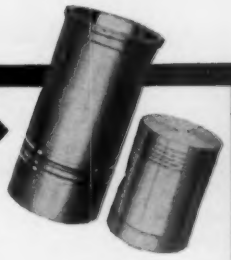
WAUKESHAS
are your *finest* OIL FIELD ENGINES
(Diesel . . . LP Gas . . . Natural Gas)

- **Favorites for Over 40 Years**
- **Rugged Construction • Precision Machining**
- **Balanced Assemblies • Modern Design**
- **Quality Control of Materials, Assembly, Testing**

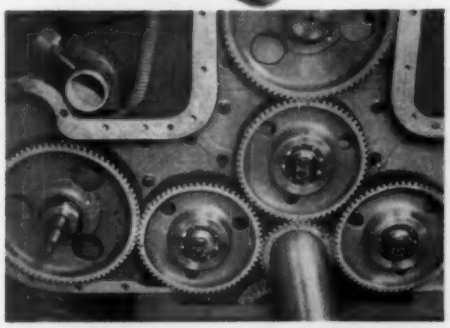


Crankshaft and main bearings in place in a typical Waukesha V-12 oil field engine. Note heavy flanges, thick bearing webs, rugged long-life construction.

Precision-built and balanced rod assemblies, matched with pistons. Pressure oiled, mirror smooth, heavy pins. Replaceable bearing shells.

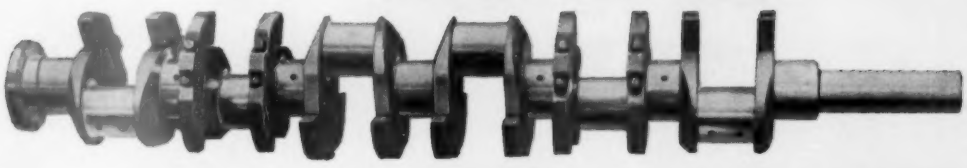


Removable wet cylinder sleeves of close-grained alloy iron, finished for oil retention and long life. Heavy duty, aluminum alloy, oil-cooled pistons.



Wide-faced helical cut timing gears are flood oiled. Materials selected for long, quiet life and accuracy. Gears and all elements in the power train, from pistons to flywheel, are precision-machined in Waukesha shops under Waukesha Quality Control.

Rifle-drilled, drop-forged, heat-treated crankshafts, precision-ground to exacting Quality Control standards. Note extra large bearing areas. Statically and dynamically balanced.



503

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Engineering Progress Report

FROM UNION CARBIDE CHEMICALS COMPANY

REDUCE GAS-SWEETENING COSTS

Two simple control tests increase plant efficiencies

Chemical analysis is the only quick and efficient method of gauging the operating efficiencies of plants that use monoethanolamine to sweeten natural gas. By proper interpretation of the simple, yet accurate tests, plants can be operated more efficiently and at some cost saving.

Quick titrations can give this information and enable the plant operator to keep safely below solution overloading, thus minimizing corrosion and solution contamination.

TEST NO. 1—ACID GAS CONCENTRATION

The total acid gas content of both the rich and the regenerated lean solutions is determined by simple titration. By comparing the acid gas contents of these solutions, before and after regeneration, the regeneration efficiency and the net solution loading can be determined. This net solution loading (the amount of acid gas removed by the solution) should check with an acid gas material balance around the absorber.

An excess of acid gas in both the rich and lean solution indicates solution overloading or improper regeneration.

When the rich solution loading is high, while the lean solution loading is quite modest (here indicating good regeneration), one of three things may be at fault: (1) Insufficient scrubber fluid circulation; (2) Insufficient amine concentration; (3) either more gas is being processed than anticipated, or the acid gas content is higher than originally expected.

An excess of acid gas in the lean solution, when the rich solution is not overloaded, indicates improper regeneration or severe solution contamination.

STEAM REQUIREMENTS FOR REGENERATION

Enough stripping vapor should be provided to the regeneration column to remove essentially all the acid gas from the rich solution before it enters the reboiler. Normal steam rates vary between 0.8 and 1.2 pounds of steam per gallon of amine solution circulated.

FLUID CIRCULATION

In plants with all carbon steel equipment the amine solution circulation rate should be adequate to keep the net solution loading at or below 0.4 moles of total acid gas (CO_2+H_2S) per mole of monoethanolamine. Under these conditions, in the conventional plant, the rich solution will contain less than 0.5 moles of total acid gas per mole of amine; and the lean solution will contain 0.1 or less moles of total acid gas per mole of amine.

Contamination can be controlled by a side stream distillation unit that removes foreign materials and amine degradation products.

TEST NO. 2—MONOETHANOLAMINE CONCENTRATION

By titrating a sample of the lean solution with standard HCl, to a pH of 4.5, the per cent of monoethanolamine free for acid gas absorbtion can be determined. This information allows for proper control of amine concentration and, therefore, proper setting of the circulation rate.

OTHER TESTS

Union Carbide has for many years maintained laboratories for the examination of scrubber solutions, and for basic research in gas treating technology. These are two of many analytical tests described in the paper "An Approach to Monoethanolamine Solution Control: Chemical Analysis and Its Interpretation." This paper relates chemical analysis to plant operation and suggests remedial steps found effective in eliminating operational difficulties. For a copy, use the coupon provided.

UNION CARBIDE is a registered trade mark of Union Carbide Corporation.

UNION CARBIDE CHEMICALS COMPANY
Division of Union Carbide Corp., Dept. G, 270 Park Avenue, New York 17, N.Y.

PLEASE . . .

☐ Send a copy of the paper—*Amine Solution Control.*

☐ Have a representative call.

☐ Send me information on_____

Name_____Position_____

Company_____

Address_____

City_____Zone_____State_____

UNION CARBIDE CHEMICALS COMPANY

UNION CARBIDE

NATIONAL BANK OF TULSA

Now our remodeling program at N. B. T. has been completed after many months of hard work. But we have done much more than just make physical changes. We sincerely believe that National Bank of Tulsa has created a New World of Banking. Our redesigned quarters exemplify modern banking's concept of full service, convenience and comfort for all our customers. The bank that was "born in the oil field" cordially invites oil men everywhere to enter A New World of Banking.

A. E. Bradshaw
Chairman of the Board

NATIONAL BANK OF TULSA INVITES YOU TO ENTER A NEW WORLD OF BANKING

member federal deposit insurance corporation

ENGINEERING

NEWS YOU CAN USE ABOUT ENGINE AND COMPRESSOR PERFORMANCE

TEFLON* COMPRESSOR RINGS... for special applications

- **TEFLON eliminates or minimizes compressor lubrication**
- **TEFLON is inert to most harmful chemicals and solvents**

Cook-engineered Teflon packing and piston rings now make it possible to reduce or completely eliminate compressor lubrication. Because of its extremely low coefficient of friction—its toughness and resiliency—Teflon is suitable for both lubricated and non-lubricated ring service.

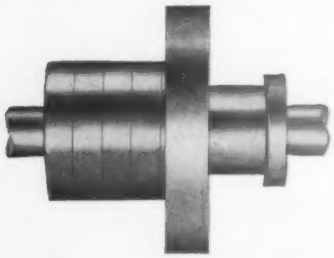
And just as important, Teflon is completely inert to most chemicals and solvents—thus prevents costly product contamination or other damage which might result with ordinary ring materials.

If your special processing applications demand "borderline" compressor lubrication, you'll want to investigate Cook's Teflon rings. You can get them any size. And they are available in many special Teflon blends, depending on your application. Ask a C. Lee Cook representative to give you the details.

**Teflon is a du Pont product of thermoplastic tetrafluorethylene resin.*

SEND FOR FREE 6-PAGE TEFLON BOOKLET

If you would like more complete information about new Teflon packings and Teflon piston rings for your specific applications, just write: C. Lee Cook Company, 934 South 8th Street, Louisville 3, Kentucky.



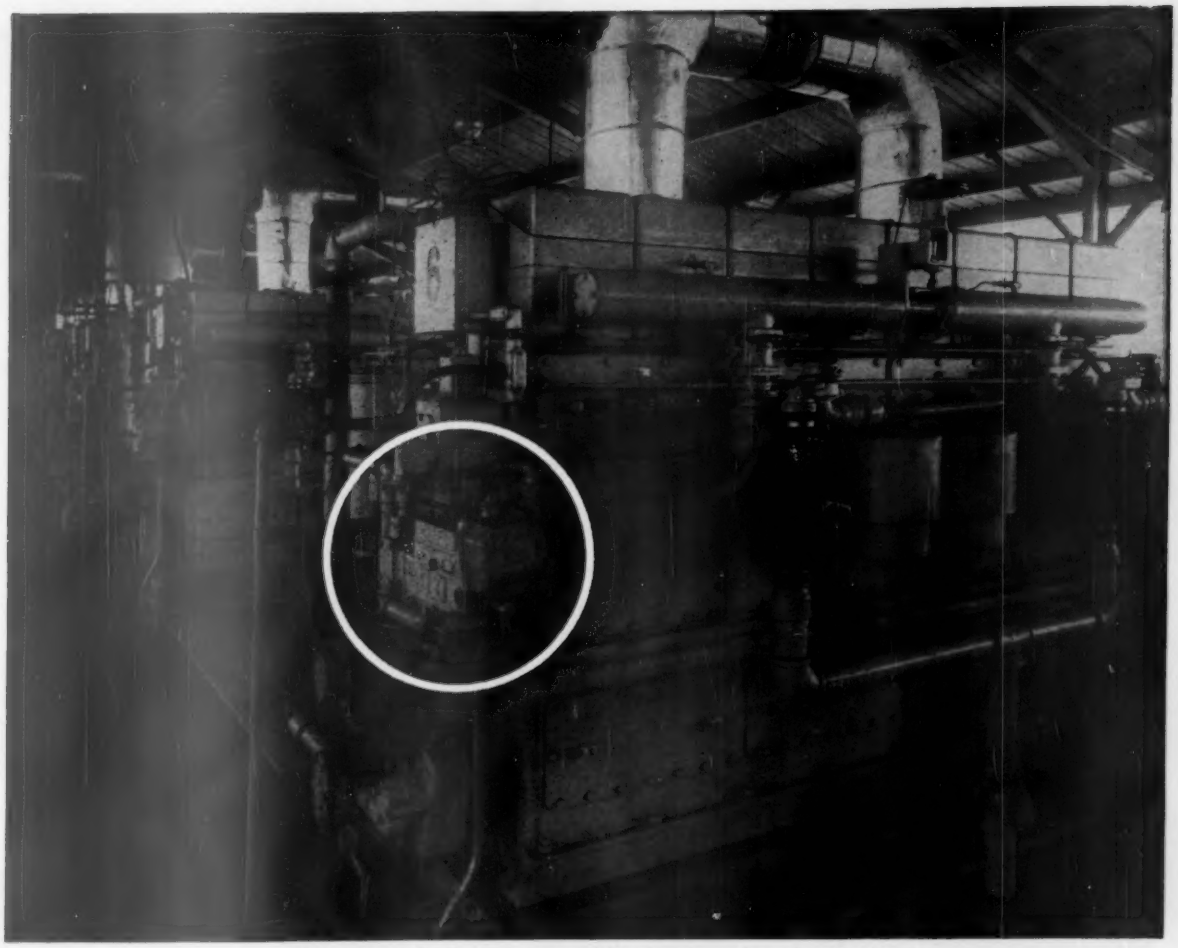
NEW PACKING DESIGN TAKES HEAT OFF TEFLON RINGS

This unique packing design now being developed by Cook keeps Teflon rings cool! It is a new idea for application where Teflon's qualities are needed, but where normal operating conditions develop too much heat for conventional designs.

C. LEE COOK COMPANY

Division of Dover Corporation

Rings and Packings Since 1888



Circle indicates Bendix LC magneto on White Superior engine at Long Beach.

BENDIX LC MAGNETOS HELP POWER GIANT LONG BEACH WATER-FLOODING PLANT

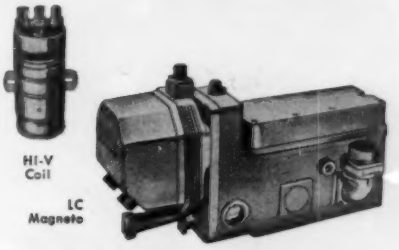
Long Beach, California, operates what may become the world's largest water-flooding plant—drawing water from the Pacific Ocean and pumping it into the Wilmington Tract beneath the city. The additional pressure created will aid in oil recovery and, it is hoped, will reduce land subsidence in the area.

Currently operating at a rate of 120,000 barrels per day, the capacity will be increased and may eventually reach 1,000,000 barrels per day—which would make it the world's largest project of its kind.

The plant is powered by eight White Superior gas engines equipped with Bendix* LC magnetos and HI-V transformer coils. These matched ignition systems, noted for long service life, simplified maintenance at low cost and complete operating reliability, can be used with engines of from six to sixteen cylinders.

If you want to know why major operators are specifying Bendix LC Ignition, write SCINTILLA DIVISION, BENDIX AVIATION CORPORATION, SIDNEY, NEW YORK.

*REG. U.S. PAT. OFF.



MATCHED IGNITION SYSTEM

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Scintilla Division

SIDNEY, N. Y.

Nash Compressors Tame "Hard-to-handle" Corrosive Gases

The reasons for the success of Nash Compressors in handling "dirty" and corrosive gases are simple. First, Nash Compressors have no internal parts in wearing contact, or requiring close tolerances and internal lubrication. Second, because of the Nash operating principle, a variety of liquids can be employed as the compressant medium, protecting the interior from corrosive action. Third, the pump casing may be fabricated from a variety of special metals and alloys. That is why Nash Compressors take these rugged jobs in stride.

Nash Vacuum Pumps offer the same basic advantages when handling corrosive gases, and reliably maintain vacuums up to 29.50 inches of mercury.

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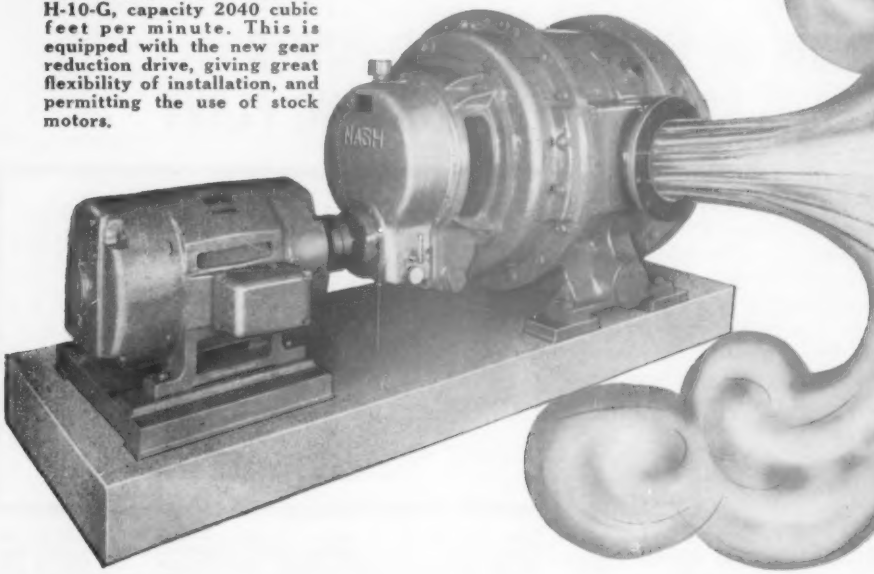
ACETYLENE
AMMONIA
ARGON
BUTADIENE
CARBON DIOXIDE
CARBON MONOXIDE
CHLORINE
ETHYL CHLORIDE
FLUE GAS
FURFURAL
HEXANE
HELIUM
HYDROGEN
HYDROGEN SULPHIDE
NITROGEN
OXYGEN
PHOSPHOROUS PENTOXIDE
SULPHUR GAS
VINYL ACETATE
VINYL CHLORIDE
AND MANY OTHERS

Shown here is the new Nash H-10-G, capacity 2040 cubic feet per minute. This is equipped with the new gear reduction drive, giving great flexibility of installation, and permitting the use of stock motors.



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SERVING ¼ CENTURY

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EFFICIENT – DEPENDABLE – QUALIFIED

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In addition to pipe lines *LATEX* offers an experienced organization for STATION CONSTRUCTION AND ALLIED WORK.

REMEMBER, LATEX QUALITY BRINGS REPEAT BUSINESS "AGAIN AND AGAIN"

LATEX CONSTRUCTION COMPANY

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"Service Life Increased 600% with URETHANE ELASTOMER parts"

says James R. Hodde, Sales Engineer
Crutcher-Rolfs-Cummings, Inc.

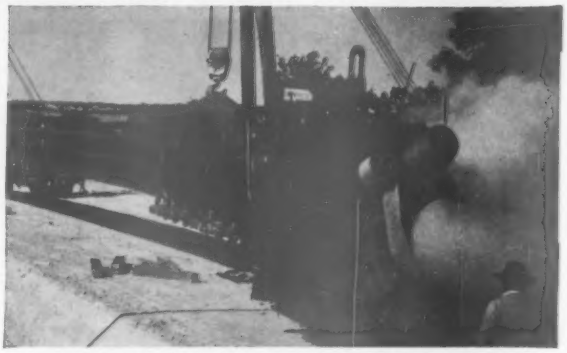
MULTRATHANE® CASE HISTORY NO. E-6.

"One of the most brutal tests for any material are the crawler wheels of equipment for cleaning, priming, coating and wrapping pipelines ranging from 2″ to 36″ in diameter," says Mr. Hodde. "Weights of our line travel equipment range up to 9,050 pounds for a 36″ capacity unit. The crawler wheel inserts, leveled at a 27″ angle, and mounted in pairs, must support the entire weight of the machine plus operator, fuel and materials as it travels along the pipeline doing its job.

"Fiber inserts formerly used lasted for only 10 or 12 miles of travel before they were worn so concave their steel flanges began scoring the pipe. Changing the inserts takes 3 to 4 hours with two skilled mechanics. In this time, 40% of the day's production could be lost.

"So dramatic has been the performance of urethane elastomer crawler wheel inserts that they have been standardized on all new equipment at our company, supplied to our specifications by the Acushnet Process Company, New Bedford, Mass. and Fort Worth, Texas."

This direct case history report from this heavy equipment manufacturer is typical of many others, testifying to the impressive savings in both maintenance and operation costs resulting from urethane elastomer's resistance to wear, abrasion and impact. Write Mobay for complete data on urethane elastomers made with Multrathane® chemicals, showing how you can put this "work-horse" material to work for you.



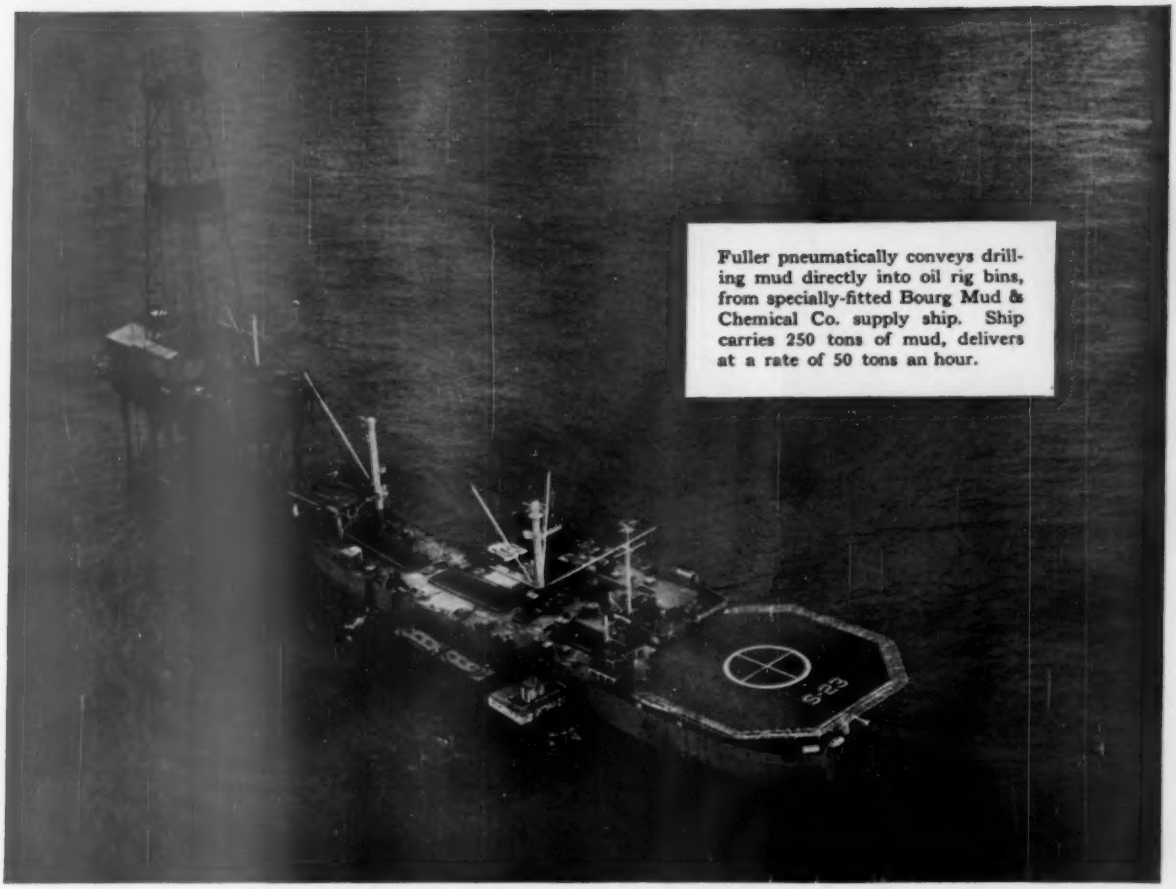
Two or more crawler wheels ride on top of the pipe as well as underneath, held in contact by spring loaded arms to insure adequate traction and prevent slippage.

MOBAY CHEMICAL COMPANY
Dept. OG-5 Pittsburgh 5, Pennsylvania

Mobay supplies Multrathane quality chemicals and technology for manufacturing urethane elastomers.

MOBAY
First in Urethane Chemistry

The Arithmetic of Materials Handling



Fuller pneumatically conveys drilling mud directly into oil rig bins, from specially-fitted Bourg Mud & Chemical Co. supply ship. Ship carries 250 tons of mud, delivers at a rate of 50 tons an hour.

Sea-Going Fuller Pneumatic Conveying System Cuts Time and Cost of Vital Drilling-Mud Deliveries

The Bourg Mud & Chemical Co., Inc., of Lockport, La., is making off-shore deliveries of drilling mud by advanced Fuller pneumatic systems.

The dry mud is automatically pumped aboard oil rigs from a Fuller equipped cargo ship at a rate of 50 tons an hour—one man replacing large crews handling 100-pound sacks in cargo nets. Previously, bag handling in high seas had been either dangerous or impossible. The highly flexible bulk-handling system now operates safely and efficiently at all times.

Self-emptying hoppers designed and built by Delta Tank Manufacturing Company installed into the Bourg ship are fitted with F-H Airslide® fluidizing gravity conveyors. A 6-inch Fuller-Kinyon pump transfers the aerated material to bins aboard the rig—over distances up to 300 feet. Air pressure is supplied by a diesel-driven Fuller single-stage vane-type rotary compressor.

Here is a good example of Fuller's engineering experience and wide range of equipment combining to solve your materials handling problem. If you handle large volumes of dry bulk granular materials, why not investigate a simple, efficient Fuller pneumatic conveying system? For details, write or call Fuller today outlining your problem.

1311
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FULLER COMPANY
GENERAL AMERICAN

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132 Bridge St., Catasauqua, Pa.
Subsidiary of General American Transportation Corporation

Offices in Principal Cities Throughout the World

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...pioneers in harnessing AIR

TEAMWORK PAYS OFF!

...when you order your pipe through the

WHEATLAND PRODUCER-JOBBER TEAM

INSIST ON PIPE MADE IN U.S.A.

You can be sure this winning combination will supply you with steel pipe of unvarying high quality, job after job. And your Wheatland distributor sees to it that you get the pipe you need . . . on time!

See your Wheatland Pipe Distributor for black or galvanized Wheatland Steel Pipe.

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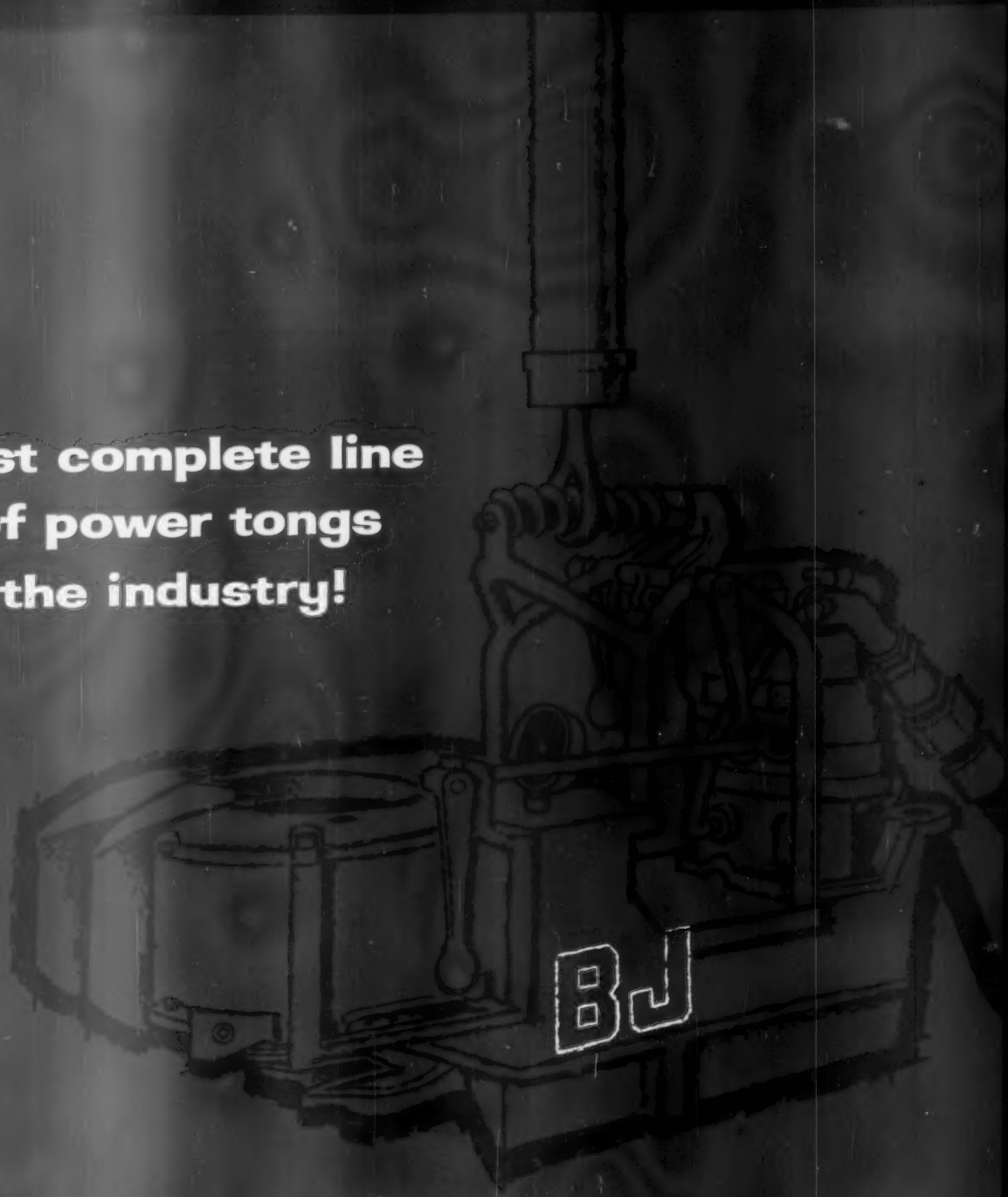
API LINE PIPE IN ACCORDANCE WITH AMERICAN PETROLEUM INSTITUTE SPECIFICATIONS

Most complete line of power tongs in the industry!



Power Pays Off—and only Byron Jackson offers a full line of power tongs. Power Sucker Rod Tongs (illustrated above) ... Tubing Tongs in Hydratorc and Super-Powairmatic models ... Drill Pipe Tongs ... Casing Tongs—BJ has them all, in your choice of air or hydraulic drive.

BJ Power Tongs provide smooth, dependable power that does the job better, faster, cheaper. All BJ Power Tongs can be quickly moved on or off the pipe ... without awkward, slow "stripping." Power Tongs insure uniform joint make-up ... reduce the chance of damaged pipe and leaky joints. Crews run more pipe with less fatigue. The result: lower drilling, production and workover costs ... more profitable operations.

You can depend on Byron Jackson power tongs ... and you can be sure that BJ quality costs less in the long run! For sizes, capacities and full details, see your supply store or BJ Field Representative.

Byron Jackson Tools, Inc.

A SUBSIDIARY OF BORG-WARNER CORPORATION

P.O. Box 2017-A, Terminal Annex, Los Angeles 54, California • Export Address: 580 5th Avenue, Suite 510, New York 36, N.Y.

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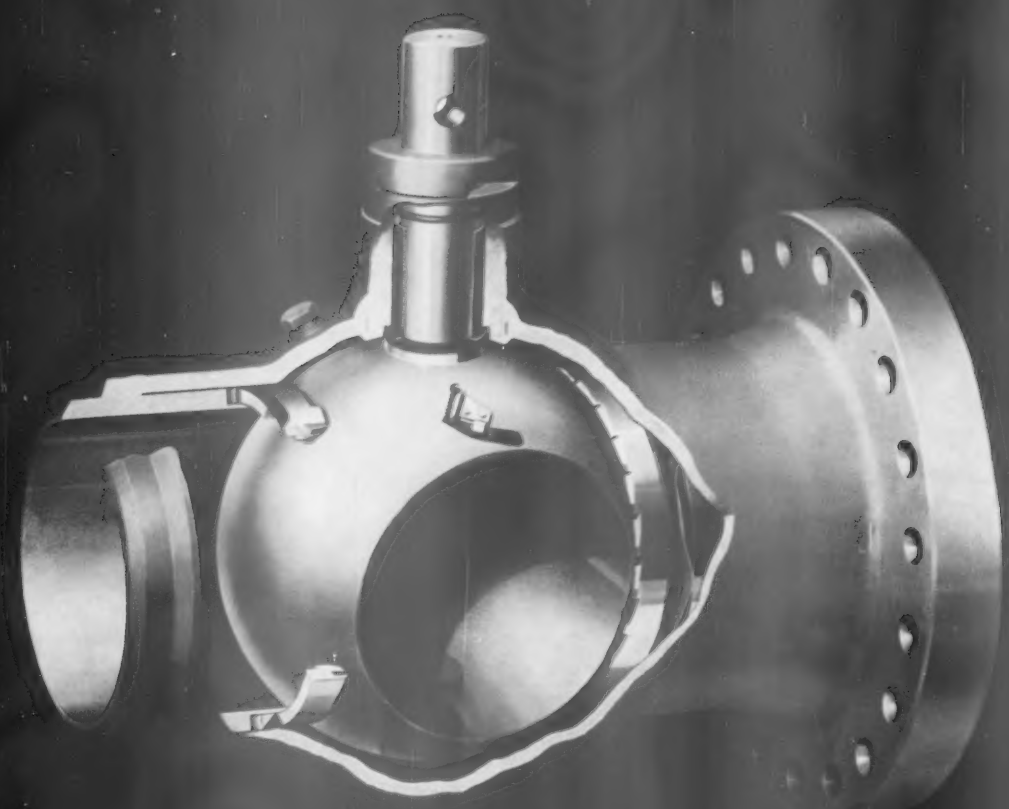

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For Pipe Lines—Chemical, Refining and Gas Processing Plants—Oil Well Drilling and Producing

Cameron

BALL VALVE

with the Exclusive Rotating Seats

These valves handle the most abrasive and corrosive fluids—cannot freeze—cannot develop excessive body pressure; provide up-stream seating, double block and bleed, all with unbelievably easy operation.

CAMERON BALL VALVES SEAL ON A NEW SURFACE WITH EACH OPERATION

ROTATING SEAT PRINCIPLE

CAMERON BALL VALVES use an advanced form of the exclusive rotating seat principle* made famous in Cameron's Type "F" Gate Valve. Each operation of the valve partially rotates the seat to change the relation of the mating surfaces and to provide a continuous reseating action.

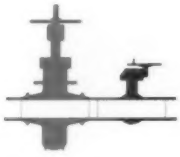
The astounding improvement in service life and tightness brought on by this advancement places the CAMERON BALL VALVE in a completely new dimension of reliability and extended use—permits for the first time "sealed for life" construction.

*Patents Applied For

NEW MANUFACTURING CONCEPT

Cameron has developed a new technique of manufacture, incorporating a new design*, which permits forging, machining and welding in successive steps. This results in a new kind of structure that is totally accurate and the ultimate in simplicity.

*Patents Applied For

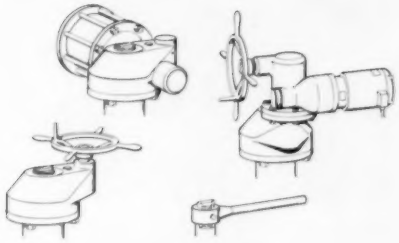


COMPACT DESIGN

This new design concept eliminates bonnets, gaskets and joints and all the problems that arise from them. The weight of these valves is remarkably low and they require only a fraction of the space needed for other valves.

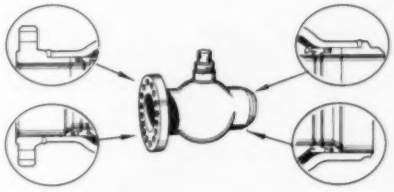
NO MORE LUBRICATION

CAMERON BALL VALVES require no lubrication at any time. Moving surfaces slide on low friction Teflon to seal all joints and provide a life-time of easy operation and bubble-tight service without lubrication.



OPERATORS

The CAMERON BALL VALVE requires only a fraction of the effort that other valves must have to operate. Much larger valves may be lever operated with ease. When necessary, highly efficient gear operators requiring a minimum of turns and effort are provided. All types of electrical, pneumatic and hydraulic operators manufactured by Cameron are available and special operation problems are solicited. Operators of other manufacture may be installed on request.



SIZES AND TYPES

CAMERON BALL VALVES are available in regular and full bore sizes from 2" to 36" in W.P. 150 psi to 5000 psi. They may be provided, with any end preparation required. Larger bore sizes are available on special order.

CAMERON BALL VALVES are available and will be manufactured worldwide in five Cameron Plants—France, England, Canada, Mexico and the United States. Processes in each plant follow the same specifications and rigid controls established by the home plant in Houston, Texas.

Cameron
IRON WORKS, INC.
P. O. Box 1212 - Houston, Texas
Export Office: 7912 Empire State Bldg., New York City, In England: Cameron Iron Works Ltd., 76 Grosvenor St., London W. 1 England

Bechtel experience at work to bring

CANADIAN GAS TO CALIFORNIA

Construction has begun on the Alberta-California pipeline which is scheduled to start delivering Canadian natural gas to Northern California during the winter of 1961-62.

The $340-million system is one of the largest pipeline undertakings ever launched—a 1400-mile, 36-inch pipeline system extending from Alberta gas fields through British Columbia, Idaho, Washington, Oregon and California.

The system has been designed to deliver initially 415 million cubic feet of gas to the Pacific Gas and Electric Company system at Antioch, California, and 152 million cubic feet of gas to other interests in the Pacific Northwest.

Three PG&E subsidiaries and affiliates are active in the system's development operation. An independent contract carrier, Alberta Gas Trunk Line Company Limited, will own and operate the main transmission line and the receiving and delivery laterals in Alberta. Westcoast Transmission Company and Montana Power Company are participating in a portion of the system and related projects.

Bechtel has prepared the engineering and economic studies and located the route from California north. Bechtel Corporation and Canadian Bechtel Limited are performing engineering and management of construction from the Alberta fields to the Oregon-California border.

ROUTE LOCATION: Surveyor locates crossing point for pipeline at U. S.-Canadian border.

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They Say—

Logic is for it

Dear Sir:

That Iowa discovery ("Iowa May Have an Oil Field," OGJ, Sept. 26, p. 267), if true, is very important for the state. There is no logical reason against oil being found there in devonian and ordovician beds. In fact, it is quite possible.

I hope the strike is confirmed as it will open the whole state to renewed activity.

Dorsey Hager
Consulting Geologist
Salt Lake City

A reprint record

Dear Sir:

Please forgive my delay in telling you what a fine job I feel the Journal did on your "Why Is Gasoline Such a Bargain?" booklet (OGJ, Aug. 1, p. 139-158).

Your efforts will certainly help our current industry public relations program on this theme.

Jack F. Gow
Public Relations Manager
Tidewater Oil Co.

Editor's note: Apparently many companies agree that this booklet will be a help in industry public relations efforts. So far a record 302,525 reprints have been ordered through Reader Service Department. The 20-page booklet is designed to tell the public some important facts about the competitive nature of the oil industry, the big tax bite, the cost of finding and producing oil, and the high quality of the industry's products. Reprints are still available.

No pigeonholing, please

"The Borden Royal Commission showed its awareness of the importance to Canada of a healthy domestic oil industry. Its words, written in mid-1959, are as valid today. Yet, in the latter part of 1960, Western Canada's oil producing industry is in a more difficult position than in mid-1959.

"With a productive capacity exceeding 1,100,000 bbl. daily, it has markets for less than one-half of potential. Despite price reductions in Western Canadian fields, which have brought prices to an average some 15% lower than for comparable oils in the United States, it is losing ground in the domestic market, and is not gaining adequately in nearby export markets.

"Canada, with crude oil and prod-

ucts imports now totalling about 500,000 bbl. daily, about five times Canada's own oil exports, has a trade deficit on petroleum account of some $400,000,000 yearly. Yet Canada is fully capable of eliminating that deficit, and greatly improving its own economic situation, by putting Western Canadian crude to greater use in Canada, in nearby export markets, or in combination of both.

"What it needs is vision and courage on the part of the Canadian Government and the adoption of a national oil policy to give direction and spur to the growth of the nation's own petroleum resources.

"The National Energy Board has recently been carefully reviewing the Borden report and the current state of the Canadian and world oil industries. We trust its recommendations will bring action.

"Certainly neither Canada's government nor Canada's economy can afford a repetition of the virtual pigeonholing that has been the fate of the Borden second report. The making of national oil policy is primarily a function of government, not of the individual members of an industry, and government has so far avoided accepting the full measure of its duty."

Carl O. Nickle, president, Conick Petroleums, Ltd., and publisher, Daily Oil Bulletin, in an article in the Daily Oil Bulletin.

Letters to They Say should be addressed to The Editor, The Oil and Gas Journal, Box 1260, Tulsa, Okla.

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. . . for ½-, ¾-, and one-ton truck chassis. All-steel electrically welded into one unit . . . watertight compartments with double panel doors. Recessed paddle handles with cylinder locks keyed alike.
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DUMP BODIES
Dump to the right, left and rear . . . the perfect dump body for windrowing, backfilling and precision dumping where space is limited. Adaptable to all standard truck chassis.
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CALENDAR OF EVENTS

OCTOBER

10-12 American Gas Association, annual convention, Atlantic City.

11-14 National Association of Corrosion Engineers, northeast region conference, Prichard Hotel, Huntington, W. Va.

12-14 Southwestern Federation of Geological Societies, annual meeting, Wooten Hotel, Abilene, Tex.

13-14 California Natural Gasoline Association, annual fall meeting, Hotel Miramar, Santa Monica, Calif.

13-15 Southwestern Legal Foundation, American Association of Petroleum Landmen, second national institute for petroleum landmen, Dallas.

13-16 Taft, Calif., Oildorado, fiftieth anniversary celebration.

14-15 University of Texas, E. P. Schoch lecture series on rate processes, Batts Hall Auditorium, Austin.

14-16 New Mexico Geological Society, annual field conference, Chama basin of northern New Mexico, registration, Taos, Oct. 13.

17-18 University of Houston, American Society of Tool and Manufacturing Engineers, symposium on the field of numerical control, Oberholtzer Hall, University of Houston, Houston.

17-19 American Society of Mechanical Engineers, American Society of Lubrication Engineers, lubrication conference, Statler Hilton Hotel, Boston.

17-19 University of Minnesota, Pennsylvania State University, Colorado School of Mines, biannual symposium on drilling and blasting, Golden, Colo.

17-Nov. 5 University of Oklahoma, School of Petroleum Engineering, short course in advanced drilling practices for engineers, University of Oklahoma, Norman.

19-20 National Association of Corrosion Engineers, north central region conference, Schroeder Hotel, Milwaukee.

19-21 Gulf Coast Association of Geological Societies, convention, Biloxi, Miss.

19-21 Rocky Mountain Oil and Gas Association, annual convention, Brown Palace Hotel, Denver.

20-21 American Institute of Mining, Metallurgical, and Petroleum Engineers, Los Angeles Basin, fall meeting, Huntington Sheraton Hotel, Pasadena, Calif.

20-23 Permian Basin Oil Show, Odessa, Tex.

21 Southern Gas Association, roundtable conference on pipeline operations and maintenance, Lamar Hotel, Houston.

23-25 Independent Petroleum Association of America, annual meeting, Statler-Hilton Hotel, Dallas.

24-25 American Society of Mechanical Engineers, American Institute of Electrical Engineers, fuels conference, Daniel Boone Hotel, Charleston, W. Va.

25-28 National Association of Corrosion Engineers, south central region conference, Mayo Hotel, Tulsa.

26-27 Armour Research Foundation of Illinois Institute of Technology, computer applications symposium, Morrison Hotel, Chicago.

26-27 Western Petroleum Refiners Association, annual question and answer session on refining technology, Rufus Garrett Hotel, El Dorado, Ark.

28 Natural Gasoline Association of America, southern regional meeting, Carlton Hotel, Tyler, Tex.

28 American Institute of Chemical Engineers, South Texas section annual technical meeting, Rice Hotel, Houston.

31-Nov. 4 University of Oklahoma, petroleum landmen's institute, Student Union Building, University of Oklahoma, Norman.

NOVEMBER

3 West Central Texas Oil and Gas Association, annual meeting, Hotel Windsor, Abilene, Tex.

3-4 American Association of Petroleum Geologists, Pacific section, annual meeting, Ambassador Hotel, Los Angeles.

3-4 Society of Automotive Engineers, national fuels and lubricants meeting, Mayo Hotel, Tulsa.

6-9 Chemical Institute of Canada, chemical engineering division, conference, Quebec City.

7-10 Society of Exploration Geophysicists, international meeting, Moody Convention Center, Galveston, Tex.

14-16 American Petroleum Institute, fortieth annual meeting, Conrad Hilton, Palmer House and Congress hotels, Chicago.

14-16 Society of Petroleum Engineers of AIME, Venezuelan sections, fourth annual meeting, Maracaibo, Venezuela.

15-16 University of Kansas, natural-gas pipeline institute, Courthouse, Liberal, Kans.

15-16 Purdue University, symposium on engineering applications of random function theory and probability, West Lafayette, Ind.

15-17 Southwest Research Institute, Air Force, Navy, industry propulsion systems lubricants conference, Hilton Hotel, San Antonio, Tex.

18 Natural Gasoline Association of America, Panhandle Plains regional meeting, Herring Hotel, Amarillo, Tex.

18-20 Roswell, N. M., Geological Society, field trip, San Andres and North Franklin Mountains, registration November 17, Las Cruces, N. M.

20-22 Fluid Controls Institute, Inc., fall meeting, Drake Hotel, Chicago.

22 Manufacturing Chemists' Association, tenth semiannual meeting and midyear conference, Statler Hilton Hotel, New York City.

27-Dec. 2 American Society of Mechanical Engineers, winter annual meeting, Statler Hilton Hotel, New York.

DECEMBER

1-3 American Chemical Society, southwest regional meeting, Biltmore Hotel, Oklahoma City.

4-7 American Institute of Chemical Engineers, meeting, Statler Hotel, Washington.

5-7 Interstate Oil Compact Commission, annual meeting, Westward Ho Hotel, Phoenix.

9 Tulane University, School of Law, and American Association of Oilwell Drilling Contractors, fifth annual program on mineral and tidelands law, University Center, Tulane University, New Orleans.

26-31 American Association for the Advancement of Science, annual meeting, New York City.

JANUARY

15-18 Pipe Line Contractors Association, annual meeting, Mark Hopkins and Fairmont Hotels, San Francisco.

16-19 Instrument Society of America, winter instrument-automation conference and exhibit, Sheraton-Jefferson Hotel and Kiel Auditorium, St. Louis.

17-19 Kentucky Petroleum Marketers Association, annual meeting and convention, Brown Hotel, Louisville.

20 Natural Gasoline Association of America, Gulf Coast regional meeting, Robert Driscoll Hotel, Corpus Christi, Tex.

FEBRUARY

7-8 University of Oklahoma, School of Petroleum Engineering, advanced petroleum engineer seminar, University of Oklahoma, Norman.

18 Purdue University, business history conference, "Management Decisions Under Government Regulation," Memorial Union, Purdue University, Lafayette, Ind.

24 Natural Gasoline Association of America, South Louisiana regional meeting, Lafayette Petroleum Club, Lafayette, La.

26-Mar. 1 American Institute of Chemical Engineers, petrochemical and refining exposition, Municipal Auditorium, New Orleans.

26-Mar. 2 American Institute of Mining, Metallurgical, and Petroleum Engineers, annual meeting, Chase and Park Plaza Hotels, St. Louis.

MARCH

7-8 University of Oklahoma, School of Geological Engineering, seventh biennial geological symposium, Student Union Building, University of Oklahoma, Norman.

8-10 American Petroleum Institute, Division of Production, southern district meeting, Captain Shreve and Washington-Youree hotels, Shreveport, La.

13-17 National Association of Corrosion Engineers, annual meeting and corrosion show, Hotel Statler, Buffalo, N. Y.

15-17 Natural Gasoline Association of America, annual convention, Baker Hotel, Dallas.

22-24 American Petroleum Institute, Division of Production, southwestern district meeting, Cole Hotel, Albuquerque.

23 National Industrial Conference Board, general session, Shamrock-Hilton Hotel, Houston.

27-29 Midwest Gas Association, annual meeting and convention, Sheraton-Fontenelle Hotel, Omaha.

28-29 University of Oklahoma, Schools of Petroleum and Gas Engineering, gas conditioning short course, Oklahoma Memorial Union Building, University of Oklahoma, Norman.

APRIL

5-7 American Petroleum Institute, Division of Production, Mid-Continent district meeting, Mayo Hotel, Tulsa.

GROWING POWER FOR THE INDUSTRIAL SOUTH

OLIN OIL AND GAS CORPORATION HAS BEEN ADMITTED TO TRADING ON THE NEW YORK STOCK EXCHANGE

Effective September 29th, 1960, the Common Stock of this Corporation and of its wholly owned subsidiary, Olin Gas Transmission Corporation, has been admitted to trading on the New York Stock Exchange. The ticker symbol is OLO.

A copy of the company's most recent Annual Report will be sent on request.

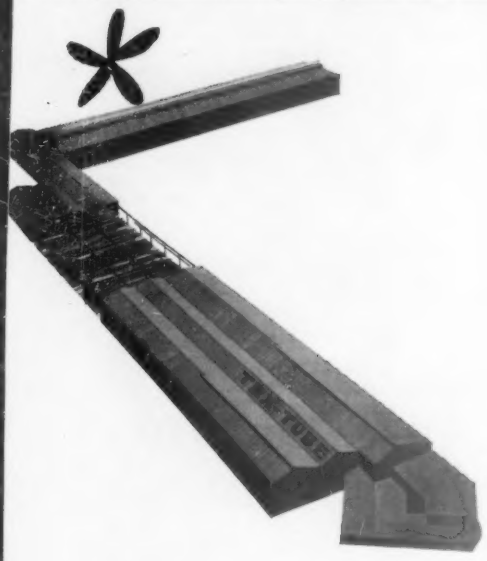
Nash & Co. will act as specialists

Company Headquarters
1700 Commerce Bldg., New Orleans 12, La.

Expanding once again . . .

1960

TEX-TUBE'S NEW PIPE MILL NOW ON STREAM!



In 14 short years, Tex-Tube has become one of the Southwest's major suppliers of light wall pipe, casing, tubing, and mechanical tube specialties. As demand for Tex-Tube products has grown, the growth of manufacturing facilities has been dramatic:

1955 — Pipe Mill #1
1957 — Pipe Mill #2
1960 — Pipe Mill #3

Now with Tex-Tube's *third* electric resistance weld pipe mill on stream it means that you—as a Tex-Tube customer—will get:

- **a wider range of sizes and walls**
- **faster, more flexible mill schedules**
- **new items available for the first time in the Southwest (without the long, expensive freight hauls from Northern producers)**

Tex-Tube has four stocking points, plus numerous jobbers throughout the South and West. Ample and varied stocks of quality Tex-Tube steel products are carried at locations in your area.

PIPE MANUFACTURERS
High Tensile Lightwall Pipe
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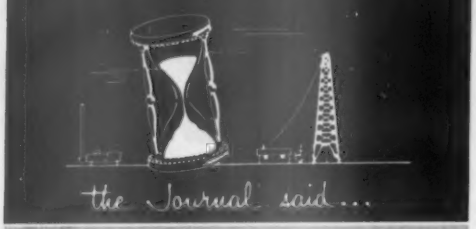
Refinery and Chemical Plant Piping

TEX-TUBE, INC.

1503 NORTH POST OAK ROAD • HOUSTON, TEXAS

Sales Offices in Midland, Dallas, Amarillo, Tulsa, Los Angeles and Pensacola



50 years ago

October 13, 1910

New 20,000-bbl. gusher drilled by Producers Oil Co. (The Texas Co.) extends Caddo field in northwestern Louisiana 1½ miles and starts another drilling boom. Field oil output jumps to 39,000 bbl. daily.

Interstate Commerce Commission backs oil transporters in their ruling to require shippers of benzene, gasoline, and naphtha to use metal barrels or drums instead of wooden receptacles. Protest of shippers against ruling turned out.

Standard Oil Co. cuts quotations of refined oil in bulk for export to 3.90 cents per gallon, lowest price since illuminating oil was established on commercial basis. Action follows report of 32½% increase in world crude-oil production in 3 years with increase of only 10.4% in world consumption of refined oil (mainly kerosine).

25 years ago

October 10, 1935

Natural Gasoline Corp., newly formed subsidiary of Warren Petroleum Co., acquires all of Amerada Petroleum Corp.'s gasoline plants, gas contracts, and gas production. Involved are seven plants with combined liquid output capacity of 158,000 gal. daily.

British American Oil Producing Co. extends Oklahoma City field northward with 5,000-bbl. gusher within 3 blocks of state capitol grounds. Drilling on capitol grounds predicted. Lease activity spreads.

Exploration activity on Gulf Coast boosts number of working geophysical crews to record high number of 107 during week. Discovery of every promising salt-dome prospect or oil structure within 2 years predicted.

10 years ago

October 12, 1950

Newly formed Petroleum Administration for Defense takes over control of responsibilities of oil and gas industry. Organization of petroleum experts set up by Petroleum Administrator Oscar L. Chapman under executive order of President Truman. Hugh A. Stewart heads new agency.

Yacimientos Petroliferos Fiscales, Argentine Government oil agency, reports discovery of first oil production on the Argentine side of Tierra del Fuego, at the south tip of the South American Continent. Initial well produces 62 bbl. daily from depth of 6,690 ft.

JOURNALLY SPEAKING

"I have this boat, see . . ."

PETE BIKE came into the office the other day, pencil poised over pad, and asked, "Any items for the interoffice news sheet?"

The news sheet is a two-page mimeographed affair written by Journal members and sent each week to the entire Journal staff.

As Pete stood waiting, I announced thoughtfully, "Well, the kids had measles last week, and my wife has been elected vice president of the Woodlawn PTA and I am finishing up a boat on which I have been working for several—"

I broke off, aware that something was wrong. "You're not writing it down, Pete. You're liable to foul up some of the details if you don't write it down. Shall I go over it again?"

Pete raised his eyebrows. "I think not. We are raising the news sheet to a higher plane."

I mulled that over a moment. "I beg your pardon?"

"We are giving up all the chitchat and small talk and devoting the news sheet strictly to bits of helpful information about things around the shop. Like who's covering what meetings, and what big stories are in the works for future issues."

I was astonished. "You think that will interest Journal staff members?"

Pete said, "Well, it'll pull a higher rating than your kids having measles."

I could hardly believe that, but he seemed determined. "Where did you get the crazy notion to eliminate the folksy, human-interest side of the news?"

"At the last editorial conference, the comment was made that the news sheet should contain more worth-while information than in the past," Pete recited. Somehow I had the impression that he had been through this routine earlier with other frustrated news sources. "It will be our intent to provide each staff member with a sort of interoffice roundup of news about Journal matters."

I considered that. Progress had caught up at last to the final holdout against business formality and efficiency, the interoffice news sheet. Everyone knows that you read a news sheet to find that Gordan Logan, of the mail room, has broken his leg and will be in the hospital for a week. Good luck, Gordon, and we're all thinking of you. That sort of thing. If you want to tell fellow staff members about some deal that concerns business you write them a memo, or catch them in the hall, or go to Portland, Ore., and remember it there and telephone back. You don't shove it in a news sheet.

I said tentatively, "I don't suppose you could see your way clear to sticking in that bit about me finishing my boat? You could make some passing remark about how, in addition to doing a fine job as assistant presentation editor, I have also finished work on my new 7½-ft. paddle boat. That way no one would realize you were putting in a personal note."

Pete drew a long breath. "Why, no. I don't believe I'll try that. No."

"Lots of interest in boats these days."

"I'm sure there is."

"Might be able to arrange for you to take a ride in it one of these days—sort of a little payola."

"You're building it yourself, you say?"

"That's right."

"Well, I believe I'll just pass that up."

I was getting desperate. "Say, we're running a special combination map and picture layout in the exploration section this week. Can you use that?"

Pete nodded. "That's what we're looking for."

"Well, start taking notes. You can quote me as saying that this layout will combine a map and picture so as to illustrate the theme of the story, which is about Africa. You can say that the idea came to me the other day when I was putting the last coat of paint on my newly finished 7½-ft. row—"

The door slammed and I looked up. Pete was gone.

And to think they let **him** write for The Journal.

—Max Batchelder

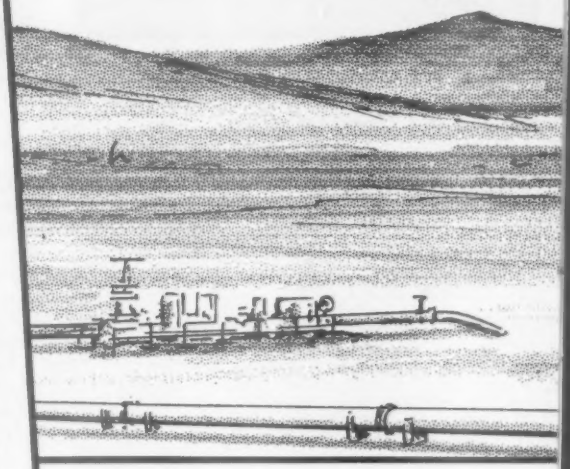
World's Largest LPG Pipe

WILLIAMS BROTHERS COMPANY SPECIFY NEW BLOWOUT-PROOF GASKETS AS FLANGE SEAL FOR MID AMERICA'S 2,200 MILE PIPE LINE.

Engineers for Mid America Pipe Line Company, had to have a flange seal to meet some of the toughest specifications in pipe line construction. They wanted the best. They wanted a gasket with maximum effectiveness,(leakage rate equivalent to welding!) easy installation, long service life, and low maintenance cost.

After exhaustive tests and investigation they chose Gask-O-Seals. Said Williams Brothers engineers, "Primarily we had to have a seal that was blow-out proof. The controlled confinement principle used in Gask-O-Seals proved exactly what we wanted."

Several thousands of these amazing gaskets seal main line and subsidiary equipment on this 2,200 mile high pressure system — the longest and largest LPG line ever built. It runs from New Mexico and Texas, to Minnesota and Wisconsin. The line and its complexes will serve millions of customers providing low cost and better service with Propane, Butane and natural gasoline.



Re-Usable Gask-O-Seals Cut Maintenance Cost

When it's necessary to tear down a flange with a Gask-O-Seal in it the ease with which bolts are "broken" and nuts unscrewed is a revelation to men used to "cracking" flanges with ordinary gaskets. The reason is simple, you simply don't have to tighten bolts as tight with Gask-O-Seals . . . in fact, on construction sites for Mid-America's pipe line you never saw a "cheater!"

Even more amazing to pipe fitters is the fact that flange faces don't have to be cleaned and that the same gasket can actually be reinstalled!

The reduced maintenance cost mounts up to a really big saving when Gask-O-Seals are specified, whether in a pipe line, refinery, processing plant, or industrial plant.

WHY GASK-O-SEALS ARE SO EFFECTIVE--

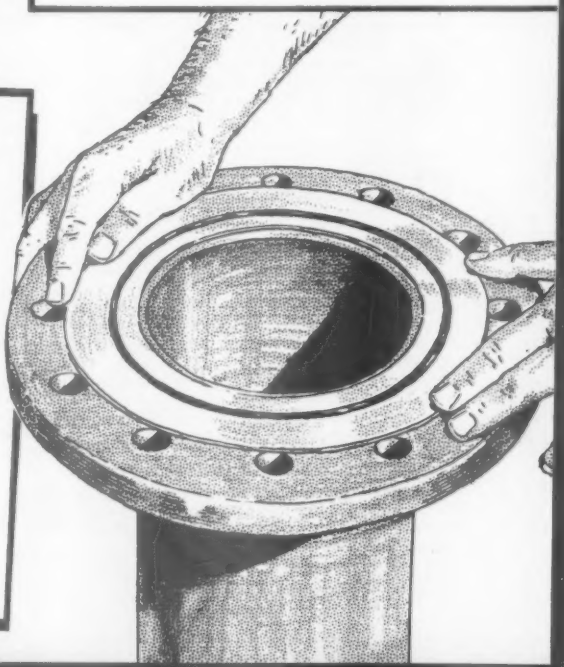
Gask-O-Seals are effective because of the sealing principle involved . . . controlled confinement. That means that the "rubber" mass to groove void is carefully controlled. The gland is totally confined with metal-to-metal contact of faying surfaces. The whole seal is designed and manufactured to carefully controlled tolerances. The Gask-O-Seal design allows very, very little area of attack on the seal itself by the materials being sealed.

Of course, there are many other features about the Gask-O-Seal that makes it unique as an effective, safe, sure seal. Some of them quite technical, others just common-sense reasons. The fact that they are used in so many vital apparatuses attests to their superior sealing effectiveness.

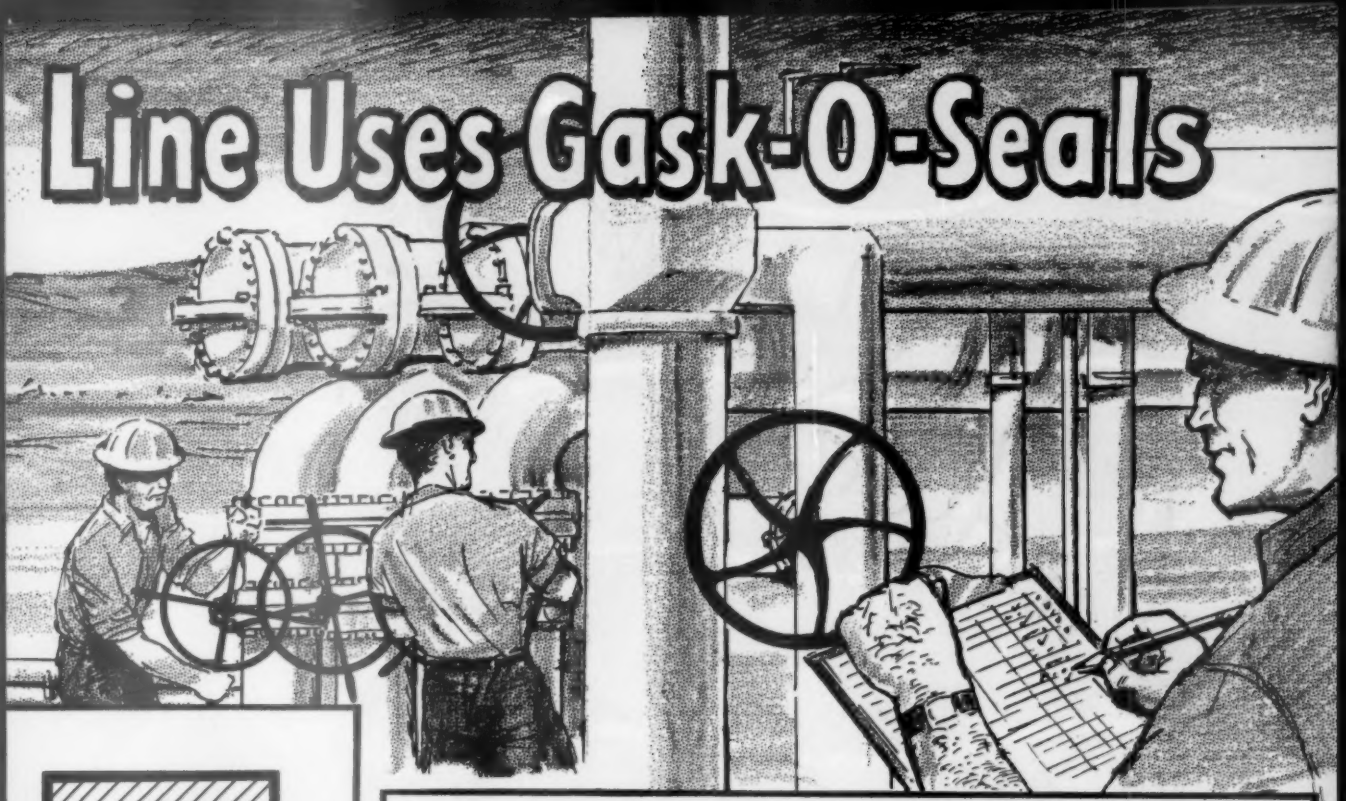
BUYERS FIND GASK-O-SEALS EASY TO ORDER—PRAISE DISTRIBUTION METHOD

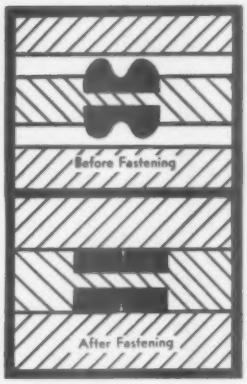
Industrial buyers find that Gask-O-Seals are readily available and easy to order with a simplified "call out" system, tieing into standard ASA flange sizes and specifications.

In addition buyers preferring local sources usually find a Parker Seal Company stocking distributor close by. More and more distributors are requesting franchises as preference for Gask-O-Seals grows. "Many of these distributors are recommended to us by purchasing men as well as engineers," says Mr. T. J. McCuiston, Vice-president in charge of sales at Parker. "Such recommendations are very much appreciated. The company will gladly consider the request of any qualified distributor for a franchise on this new product line."



Line Uses Gask-O-Seals





Underwriter's Lab Tests Gask-O-Seals, Approve For Listing

LISTED UNDER REEXAMINATION SERVICE — UL — UNDERWRITERS' LABORATORIES, INC. OF

To be sure that customers could have confidence in the competitive safety of Gask-O-Seals, Parker Seal Company submitted all of standard ASA flange series seals to Underwriter's Laboratories for testing. They have approved all four of the series 6400, 6420, 6430, and 6440 for listing under their re-examination code, and granted permission to use their insignia for the services covered.

HOW TO SAVE *19 MINUTES* EVERY TIME YOU "BREAK" A FLANGE!

A testing foreman on Mid-America's pipe line saw Williams Brothers men installing Gask-O-Seals in flanges at the Conway, Kansas, Terminal. He turned to the Parker Seal Co. representative standing nearby and said:

"Man, go see my boss about those gaskets. I'm saving hours and plenty of money with them. We can just put 'em in for a test, break up and move, and *re-use the same gasket, over and over again!*"

A maintenance foreman said Gask-O-Seals may save them "2 days time of two 4 man crews-with trucks, wenches and other equipment."

A survey shows it takes an average of 36 minutes to remove and install an ordinary gasket after several months use. With Gask-O-Seal it takes only 17 minutes! Here's how it breaks down:

3 minutes saved in "breaking" nuts, 3 minutes saved in parting flanges to necessary working space, 13 minutes in not having to clean and scrape flange faces — and you can install the same Gask-O-Seals you take out!

A worthwhile saving?

OVER 1,000,000 GASK-O-SEALS USED UNDER THE VERY TOUGHEST CONDITIONS BY AIRCRAFT AND MISSILES.

The sealing effectiveness and high safety factor of Gask-O-Seals were first recognized by the aircraft and missile makers to whom, safety, and genuine effectiveness of a seal is paramount.

Hundreds of tests have been run on Gask-O-Seals under some of the most rugged functional and environmental specifications a seal can undergo.

Today, Gask-O-Seals—much the same as the ones used on Mid America's new pipe line—are in use on practically every military and commercial aircraft. A Gask-O-Seal, for instance, seals the escape hatch and other openings of the Mercury capsule on the "man-in-space" project.

Send for this FREE catalog →

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Culver City, California and Cleveland, Ohio

A DIVISION OF PARKER-HANNIFIN CORPORATION

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QUALITY • QUANTITY • SERVICE

ASSURE YOU OF DEPENDABLE DELIVERIES OF

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TULSA, OKLAHOMA

EXPORT TERMINALS: CORPUS CHRISTI, PORT ARTHUR, BAYTOWN, TEXAS CITY AND WARRENGAS, HOUSTON, TEXAS, SAN PEDRO, CALIF.

This FPC plan has very real power

THE MORE THE MATTER is studied the more evident it becomes that the Federal Power Commission has taken a big step in regulation of producer prices and that the step is very much in the right direction.

A great many flaws can be picked in the new policy, a great many doubts conjured up about its future operation. But in a realistic appraisal the program looks exceedingly promising.

If FPC's promises of future actions to improve the plan can be taken at face value, and if the industry will cooperate in good faith, the new policy can begin to bear constructive fruit within a few months.

LOOK AT WHAT'S BEEN GAINED. Producers are no longer utilities. The rate-base formula is scrapped. Gas is to be priced as a commodity. Those are principles producers have always held.

Gas prices will bear a resemblance to posted prices for crude oil. Eventually all producers and buyers in an area will have approximately the same price. Such stabilization and uniformity will help producers, pipeliners, distributors, and consumers.

The concept of the plan is sound. It is chiefly the mechanics of it that raise doubts and criticisms. But these can be improved and perfected unless blocked by obstructionist tactics.

Certainly the announced area ceilings are too low and the differentials within and among them are inequitable. But they are all that FPC could justify on the basis of evidence now before it. And they are only administrative guides—just a starting point for discussion.

If these ceilings should become permanently frozen they won't do the job of providing the industry with necessary funds to increase gas supply. But FPC must have reliable proof of this before it can raise them. And it has outlined the kind of proof it needs.

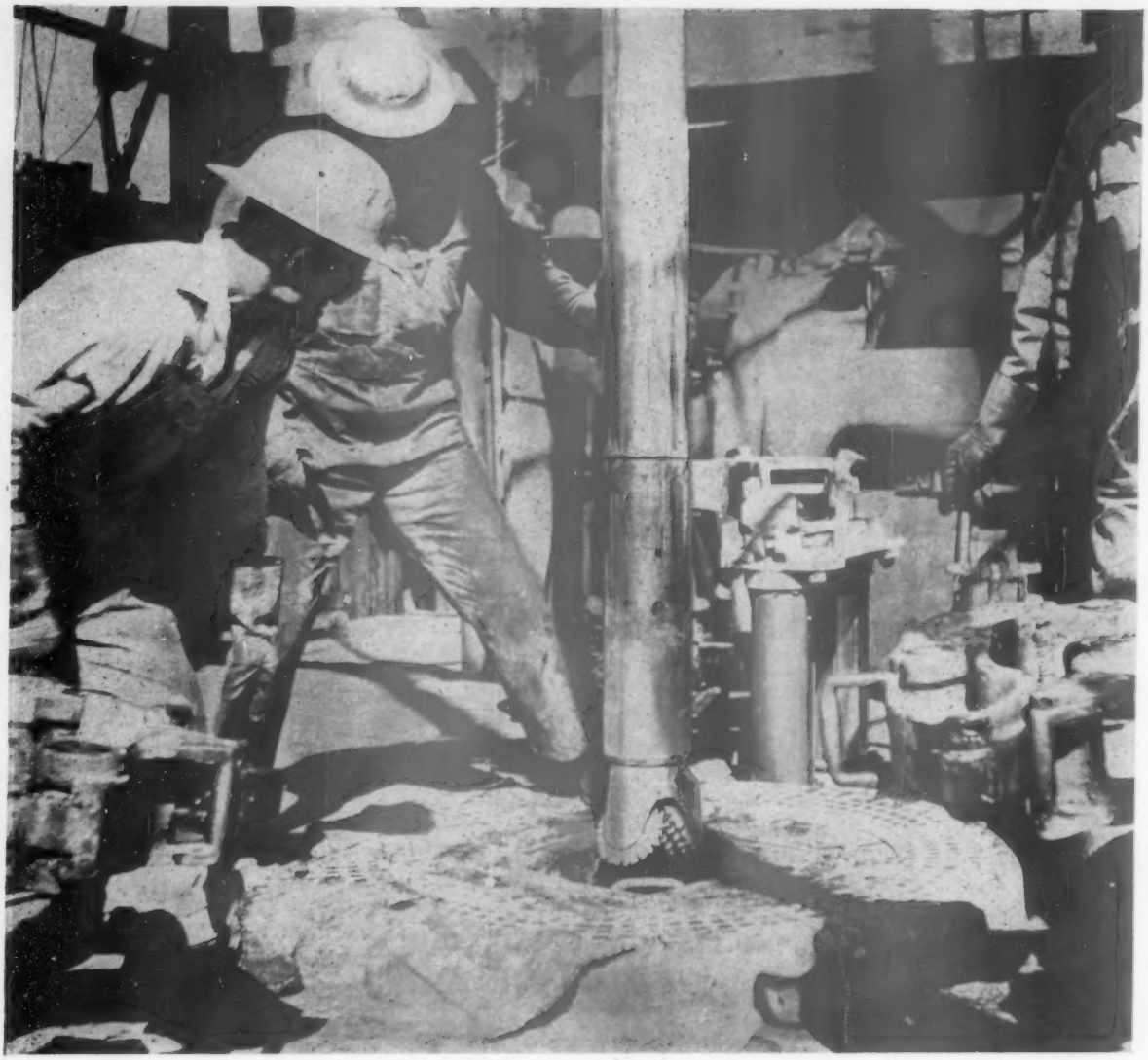
Now it is up to producers to accept the invitation by justifying price increases through a different approach from those in the past. This will require fresh thinking, unfamiliar procedures, and cooperative action.

This is a big task, and progress will be slow. But the way is opened for progress at last.

A NEW LAW IS STILL NEEDED. The FPC action points this up more sharply than ever. And there is at least an even chance that it will speed up rather than delay agreement on legislation.

Until now legislation has been stymied by wide disagreement on any alternative to rate-base regulation. Now FPC has broken the jam by experimenting with one alternative. Whether it works or not, this should stimulate creative thinking toward a proper law.

In the meantime this new policy promises considerable relief. If the industry cooperates realistically and earnestly, perhaps it can be made to work well enough to point the way to a permanent solution.



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NICKEL MAKES STEEL PERFORM BETTER LONGER

FPC's New Policy:

Producers are Hopeful, But Skeptical

• Say the optimists: Action is better than inaction and the cost-of-service formula is dead. Say the pessimists: Things will get worse, but there will be delay in legislation while everyone waits to see how the new deal works out.

Henry D. Ralph
Chief Editorial Writer

HARDLY ANYBODY in any division of the gas industry has firmed up an opinion about the Federal Power Commission's new policy statement outlining an area-price-ceiling method of determining just and reasonable prices for gas producers.

Some think it may prove to be a step in the right direction. Others think it will soon bog down into the same dead end of confusion and frustration that the industry has been in for 6 years.

But the almost universal reaction is: "I just don't know what to think about it yet."

Such was the situation at the annual convention of the Independent Natural Gas Association of America, where some 500 producers, pipeliners, and distributors spent 3 days asking each other about the new policy and getting no answer at all.

But in general, optimism outweighed pessimism. The optimism had two bases:

. . . **Action is better** than inaction. At last the commission has got off dead center, made a decision, and grasped the bull by the horns. It may or may not get far, but at least it's doing something—and that's hopeful.

. . . **FPC has served notice** on Congress, the courts, its staff, and everybody else that the cost-of-service rate-base formula has been abandoned as unworkable, that gas producers are not to be regulated as utilities, and that gas must be priced as a commodity—and that is a genuine victory.

Pessimism . . . The most outspokenly disappointed are those who view the action as simply postponing remedial action by Congress.

With continued inaction, they reason, the situation would soon be so chaotic that Congress would have to pass a new law soon.

Now Congress will be inclined to wait to see how the new policy works. But they think that the plan won't work and in a couple of years things will be worse than today. So the new plan is like taking a pain-killer instead of having a needed operation.

Optimism . . . A contrary view—held by about an equal number—is that this will hasten legislation of the proper kind.

This is based on the assumption that it would be politically impossible for Congress to write adequate legislation in 1961 under any circumstances.

So, it is argued, FPC's clean break from the utility concept and its attempt to explore new ground will make it easier for Congress to consider the subject calmly and will swing former opponents around to the view that the new law is necessary.

Skepticism . . . Producers who in the past have been skeptical of any of the various suggestions for area pricing methods—and that includes the majority—fail to see much merit in this plan.

Much of this stems from their ingrained resentment against any form of regulation. More practical is their fear that while the area plan may appear to work at the start it will soon degenerate into a permanent freeze with no flexibility in prices.

Likewise, serious reservations are expressed by those big producers who, in their FPC rate cases, have been arguing for consideration of area prices as a substitute for the cost-of-service formula.

They point out that having FPC consider general conditions in a producing region as a factor in passing on the reasonableness of a contract is one thing, but it is quite a different thing to have specific ceilings set for all contracts in a single area.

For the past year or so quite a few pipelines and distribution companies have been suggesting that some form of area pricing approach might be the solution. But they seem to have as many doubts as the producers about how this particular plan will work out in application.

Practically all producers complain that the ceilings are too low. They all appear to be on the low side of the going average, and the majority of contracts are already close to, if not above, them.

In some areas, it is true, a good many producers are not yet getting the ceiling and—where they can find willing buyers—they can now get their prices up to the ceilings without fighting a case through FPC.

There is also severe criticism of differentials between adjoining areas. FPC says it will consider evidence showing that such differences should be eliminated and that any area ceiling should be pierced or raised. But most producers feel that, as a practical matter, most ceilings are pretty well frozen.

The differential between prices for old contracts and new gas is severely criticized. However, there is good reason to believe that this was done largely for political effect so as not to alarm purchasers, and that FPC intends to let old contracts gradually escalate up to the new-gas levels in perhaps a majority of cases.

Procedure? . . . The unanswered procedural questions are legion. No one, including the FPC commissioners, can tell just how producers should go about justifying prices above the ceilings.

The commission can say only that it will work things out as it goes along and will issue new or amended policy statements from time to time.

One thought is almost universal: FPC does not consider its new plan to be the ultimate solution, or per-

FPC's New Policy:

haps not even as pointing to a wholly satisfactory method of regulation. In fact, there is a well-grounded feeling that FPC looks on the policy as little more than a temporary expediency that may loosen up its log jam of cases for a while.

For this reason, those who have always contended that there is no possible way to regulate producer prices except by caprice are predicting that the new plan will simply substitute a different brand of chaos and will prove to be as impractical as the old.

For the same reason, other gas men hail the action as a declaration of independence from the courts, from the FPC staff, and from others who have insisted on the cost-of-service formula, and now that that has happened the way is cleared for experiments that may develop a practical regulatory method.

But nobody in the entire assembly at INGAA thought that this FPC action lessens the need for new legislation.

For even if the plan should develop into a satisfactory method, it would need the backing of a statute to keep it from being destroyed by court actions.

WASHINGTON representatives of oil companies lost no time after word spread that the Phillips case had been decided. Here they're lined up in FPC offices to get their copies of the decision.

What Next? FPC Isn't Altogether Sure

THE FEDERAL Power Commission is feeling its way into a new field in its policy of setting producer gas prices by area ceilings instead of the cost-of-service formula.

It just is not prepared to answer most of the questions producers are raising about the new plan.

Chairman Jerome K. Kuykendall made this clear in a prepared talk and a lengthy question period at the INGAA meeting in Miami Beach.

Kuykendall made it plain that FPC is prepared to experiment, to seek practical solutions to individual problems as they arise, to develop procedures gradually, to issue additional policy statements, and perhaps to change its mind.

But always the commission must keep in mind that affected parties may appeal to the courts if they feel they have been denied due process of law.

The area prices in the policy statement schedule, he emphasized, are not a determination of just and reasonable prices but simply an administrative guide.

FPC can't fix prices by edict. It can't raise low prices up to these levels nor roll back higher prices to them. Such action must come through passing on specific contracts.

A commission guide . . . But in passing on contract prices, FPC will be guided by the economic considerations mentioned in its policy statement, plus others, instead of an individual producer's costs.

And it anticipates that large groups of producers and buyers will join in presenting evidence affecting an area price.

Escalations or new contracts not above the published ceilings will not be suspended or conditioned. This is expected to clean up a considerable backlog of pending cases.

Filings above the ceiling will be suspended or conditioned until, at a consolidated hearing, it is demonstrated that the entire area ceiling should be raised or that particular kinds of contracts are entitled to higher prices.

Deeper production might be a factor justifying a price above ceiling, in addition to the factors listed in the policy statement. Kuykendall suggested that FPC may find it advisable to redefine its areas vertically for deep and shallow production.

Prices now in effect above the ceilings and not presently in controversy will not be rolled back unless somebody brings a new case challenging those prices as being in conflict with the policy statement.

Pending cases involving above-ceiling prices will be determined on the basis of the new policy. Where a case is virtually completed on cost-of-service evidence, it is probable that it will be decided much like the Phillips case unless the parties wish to reopen it for further hearings under the new policy statement.

The discrepancy between new and old contract prices will be reduced or perhaps entirely eliminated in time through renegotiation of old contracts where FPC can be shown that the new-gas price is justified.

Logic will be used . . . As an example, Kuykendall took the case of an old natural-gasoline plant with 11-cent contracts competing against a newly built plant where the ceiling for new gas is 17 cents.

The commission wants to be sensible in its decisions, he said. It would

recognize the impossibility of such a situation and doubtless could be convinced that the old plant should have the same buying prices as the new one.

Apparently the question of gas produced by a pipeline or its affiliate is a hot potato. Several times the chairman said that in his personal view such gas should be subject to the same pricing policy as independent producers, but he could not speak for the whole commission on this matter.

Procedures have yet to be worked out. Pending cases involving individual contracts above the new ceilings may have to be reopened to permit intervention of all producers and purchasers in the area. Or new consolidated hearings might be held on the question of changing the ceiling prices.

Kuykendall emphasized that it will take much cooperation from the industry to get all relevant data before the FPC without making the hearings too lengthy, and he urged extensive use of pre-trial hearings and consolidation of related testimony.

Producers may continue to present cost-of-service evidence if they desire. But they cannot use their own high costs to justify prices above the going rate in the area, Kuykendall said, because FPC is not going to bail out inefficient or marginal producers.

A more sensible procedure, he said, is to base a case for higher prices on industry cost trends and economic data without trying to translate this into a rate base.

There'll be realism . . . More and more, he said, FPC hopes to base its decisions on its judgment of economic realities rather than on arithmetic formulas.

The chairman said it was expected that the new policy will open the door to an era characterized by sensible procedures and sound economic standards for fixing just and reasonable rates for producers.

He said the area prices that have been set probably can be criticized, and with justice. But this would be true no matter what levels were announced.

The area-price policy is by no means the final answer, Kuykendall said, and it may develop a great many unanticipated problems. But, he added, FPC had to do something when it concluded that cost-of-service is unworkable, and the area approach seemed to be the least objectionable of any of the alternatives considered.

In the meantime he asked the cooperation of all branches of the industry in helping FPC work out a fair and reasonable method of regulating producer prices in the absence of new legislation.

FPC's New Policy:

Odds Poor for a Gas Bill Soon

. . . in the opinion of Harris and Kuykendall. However, they agree there's a need for congressional action.

LITTLE CHANCE of early legislation clearing up the confusion over producer prices of gas is seen by either Chairman Oren Harris of the House committee on interstate and foreign commerce, or by Chairman Jerome K. Kuykendall of the Federal Power Commission.

In a prepared speech to the INGAA meeting in Miami Beach, Harris said:

"The restatement of congressional policy respecting regulation of producer prices has been difficult to achieve and I know you are familiar with the various measures that have been introduced, the steps that have been taken, the bills that have been reported and passed and vetoed during recent years.

"It is obvious that some sort of solution to this knotty problem still is needed, but I am not certain that any of the suggestions that hitherto have been made provide the remedy that can be incorporated into legislative policy.

"I feel that the time has arrived when somehow those who are interested in the matter must come up with a completely new approach, but what it may be I cannot now suggest."

Kuykendall, after explaining that the new FPC policy statement on area pricing leaves many problems unsettled and must still be tested in the courts, said:

"Most of the trouble and confusion which is yet to come could be avoided by appropriate legislation by Congress, but that appears to be a most remote possibility."

Later at a joint press conference Harris said that in view of the history of such legislation there is not much hope of action by Congress in the near future, and it may be inadvisable to make an attempt next year.

He said the FPC policy statement does not affect the legislative situation.

Kuykendall emphasized that the policy statement does not in any way lessen the desirability of new legislation, but said there is a good chance that it will point the way to a legislative solution.

Kuykendall said the new policy has many similarities with the Harris bill, which attempted to define a fair market price for gas, since FPC is now working toward the same result.

Harris, however, said it is too early to say whether or not there is any similarity, pointing out that producers are still treated somewhat as utilities and that FPC has not been able to get entirely away from the cost concept in setting prices.

Procedure Will Have to Evolve

THE QUESTION that naturally arises as a result of the announcement of a new policy of gas-producer regulation is just how and when the Federal Power Commission will put into effect its new area-pricing approach.

The answer: No move will be made in specific cases soon, and details of procedure will evolve gradually.

Thus, for the near future, suspended rates will remain suspended, and any new sales approved will be approved with conditions.

There are several reasons why these are safe assumptions.

In the first place, the commissioners themselves have not yet worked out details of procedure. They sought, in the Phillips case decision and the accompanying policy statement, merely to set the broad framework for the future.

Furthermore, since the commission's new policy move is linked so closely with the Phillips case, nothing further is likely to develop until the next step in the Phillips case is taken.

By FPC rules, Phillips and other interested parties have 30 days in which to file a petition for a rehearing. Following that, the FPC has 30 days in which to take action.

Regardless of what happens then, apparently there will be no legal grounds for a court test of the area-pricing procedure because the commission did not apply that approach in the Phillips case. Nor has it set forth the new policy as a formal order.

A court test probably will have to

FPC's New Policy:

await a case in which area pricing is specifically used.

Meanwhile, there is a strong possibility that the FPC will try to clarify the situation somewhat by issuing further policy statements in which it will seek to be more specific in its approach.

The next statement probably will be announced when the commission makes known, about 2 months from now, its decision on any petitions for rehearing the Phillips case.

During this period, the FPC staff undoubtedly will be checking through the backlog of cases to determine which ones might be disposed of promptly as soon as the new FPC policy takes definite shape. But the staff itself will need more guidance from the commissioners before it can make much headway on even the preliminary steps.

The net effect is that the wheels of the regulatory machinery will continue to grind slowly, at least for a considerable time.

Despite these uncertainties, some outlines of the new procedure are discernible now.

For one thing, it is evident in the commission's policy statement that individual producers will have difficulty in winning approval of a price higher than the one set for their area.

Although the FPC said that each producer will have a right to seek a different price, is is clear that individual adjustments are likely to be extremely rare.

This stems from the FPC view that it should set prices on the value of the gas and the needs of the industry as a whole rather than on the costs of an individual producer.

Therefore, a producer will not be given a higher price merely because he is able to show that his costs are higher than the average in his area.

The principal hope for any price change will be in group action by producers to convince the FPC that an area price should be raised.

Some FPC officials fear that these area-pricing cases will become so involved they will be as slow and cumbersome as the old FPC rate-base approach.

The FPC itself seems to have some fear of this. It said in the policy statement that producers should seek to use prehearing procedures and other procedures aimed at keeping area-price hearing testimony to a minimum.

Unless some such method is followed, the current backlog of cases at the FPC will be whittled down very slowly, if at all.

Analysis of Gas Needs Asked

. . . with serious study of financial requirements to meet those needs. Says Gulf: Demand will double in 10 years.

A HIGH-LEVEL commission has been proposed to study the future demand for natural gas and the financial requirements needed to maintain a supply.

David T. Searls, vice president and general counsel of Gulf Oil Corp. took his cue from a Federal Power Commission statement in the Phillips case decision.

The FPC said in effect that the ultimate solution to independent producer rate regulation lies in determining fair prices for gas, based on reasonable financial requirements for the industry.

Searls suggested to the INGAA meeting in Miami Beach that an objective study of these requirements should be carried out.

He said such a study might be made by interested trade associations plus representatives of state utility commissions. Or, he said, it could be made under FPC sponsorship.

Another alternative would be for the President to create a cabinet-level task force to handle the job.

New INGAA Head

W. E. Mueller, president of Colorado Interstate Gas Co., was elected president of the Independent Natural Gas Association of America.

Other new officers are W. M. Elmer, president of Texas Gas Transmission Co., first vice president; Orville S. Carpenter, president of Texas Eastern Transmission Corp., second vice president.

As a starter, Searls offered a study just completed by Gulf.

During the next 10 years, the study said, demand for gas will rise from the current 10 trillion cubic feet to from 18 trillion to 21 trillion cubic feet a year.

The reserve-production ratio now indicates a 20-year supply, compared with 30 years in 1946. And most of the known reserves already have been dedicated.

This means new supplies must come from new discoveries. Our present discovery rate is not high enough to meet the future demand, the study said.

More drilling needed . . . Assuming that the reserve-production ratio can safely drop to 15 years, it will be necessary to find and develop 220 trillion cubic feet in the next 10 years.

Figuring that 15 trillion could be supplied by imports, 205 trillion must be developed domestically.

This will require drilling an average of 62,500 wells per year, compared with a probable 44,000 this year.

It will require $92 billion during the decade, and if the reserve-production ratio is to be held at 20 years it will require an additional $34 billion and 300,000 wells.

If crude oil stays at $3 a barrel and gas prices rise according to the trend of recent years, the industry's gross income will be only $92 billion during the decade. This wouldn't provide enough incentive for additional exploration.

Searls concluded that the issue is whether the American people want much more additional gas and are willing to pay for it. If not, they should plan to switch to other fuels in the future.

Those who oppose all price increases cannot continue to hide their heads in the sand by saying they want more supply but not at contract prices.

Idea given support . . . Searls talked before the producer committee and was followed by Atherton Thomas, assistant to the vice president of Consolidated Edison Co. of New York, as spokesman for distributors.

Thomas completely agreed with Searls' premise that producers must have adequate incentive if supply is

to be maintained, and he endorsed the proposal for a joint study and educational campaign.

But he warned that gas prices cannot go too high too fast, or consumers will become alarmed and will shift to other fuels.

Producers must realize that there is an economic ceiling on gas prices, he said. In some Atlantic seaboard areas gas is already more expensive than oil or coal.

Thomas said distributors have finally learned with a shock that there is no Santa Claus to continue to bring them cheap gas and that they must pay a fair price for it. But before a fair price can be defined the economics of the industry must be better understood.

Curb on FPC Staff

. . . is proposed to stop ex parte contacts.

THE STAFF of the Federal Power Commission was the subject of sharp criticism by two speakers at the INGAA meeting.

Rep. Oren Harris of Arkansas announced that next January his House committee on interstate and foreign commerce will press for legislation to prevent staff members, as well as industry officials, from making off-the-record contacts with regulatory commissions in quasi-judicial proceedings.

"Basic fairness," Harris said, requires that staff members who might become advocates of a particular point of view should not participate in ex parte communications with commission members.

With such legislation, staff members, Harris said, would be on a substantially equal footing with outside parties, who are prohibited from ex parte contacts in on-the-record proceedings with agency members.

"Any advocacy engaged in by such staff members should be limited to on-the-record presentation, and it is the purpose of this bill to bring this about," Harris said.

Chairman George R. Perrine of the Illinois Commerce Commission blamed the FPC staff for delaying approval of projects to bring new gas into deficit areas by attempting to shave a few cents off the price and by inquiring into every detail.

"To put it very bluntly," Perrine said, "it seems to me that the FPC staff assumes the position of protecting the public from the very commodity it wants, and it appears that the Federal Power Commissioners, themselves, are powerless when they attempt to expedite these hearings.

watching WASHINGTON

Clyde La Motte

• Will U. S. oil scene impress the Russians? . . .

WITH A DELEGATION of Russian oil men due to arrive in this land this week, one is inclined to wonder what their reaction will be to the sights they will be shown in the oil industry and elsewhere.

A reporter broached the subject to W. W. (Bill) Keeler, who was chairman of the U. S. oil group that toured Russia recently, when Keeler and other members of the delegation were in Washington for a "debriefing" by the State Department.

Keeler, trying to fit himself in the shoes of a Russian seeing the home of the capitalists for the first time, said he thought the Russians would undoubtedly be impressed.

He thought a Russian refiner, for instance, might have trouble suppressing a touch of envy at seeing some modern U. S. plants with Platforming and other processes that the Russian refiner doesn't use.

However, the Russians will also probably tend to rationalize along these lines: "We could do the same thing if we wanted to, but much of this is unnecessary and wasteful. Our refineries are perfectly capable of producing the products we need."

But he will ask questions about desulfurizing and desalting because much of the Russian crude oil has a high sulfur content.

• One point of interest: Offshore activity . . .

In the oil patch, the Russian might be less impressed. The Soviets have stressed this phase of this industry and have done a good job of developing techniques for locating oil, drilling, and production.

Matter of fact, the Russian might toss in some remark about what effective use they have made of the turbodrill and the progress they are making with the electric drill.

Even so, he will be interested in the deep wells that have been drilled in this country, and he is eager for an inspection of offshore-drilling operations.

The Russians will be interested in pipelines, too. Their current program has as its goal the building of 26,000 miles of lines because the Russians want to make that the backbone of their oil transportation system.

• "All those service stations and automobiles" . . .

One thing that is certain to amaze them, whether it impresses them or not, is the sight of so many lavish service stations. In Russia the stations are few, and are tucked away on side streets where the consumer has to search them out. The Americans saw six stations during their 7,300-mile trip.

And Keeler is certain that the Rusisan eyes will bulge at the sight of traffic on some metropolitan thoroughfares. By comparison, Russian traffic is a trickle.

Keeler suspects that the biggest impression of all may be made on the Russians when they tour through a typical American shopping area. The display of a seemingly endless variety of consumer goods may cause them to revise some pre-trip impressions of this land where, their propagandists say, unemployment is such a problem and the poor worker is ground under the heel of the greedy capitalist.

One of the other members of the tour of Russia, George Getty II, feels that the U. S. may not contain too many surprises. After all, he reasons, the Russians have learned of many of our technological advances through trade and technical publications, and the movie screen has brought him views of Americans at work and play.

But Getty agreed with Keeler that the Russian visitor is likely to blink in amazement at the number of automobiles he sees rolling on U. S. highways and byways.

Power Plants for 1961 Cars

	Eng. Type	Carburetor	Compression Ratio 1960	1961	Change	Horsepower 1960	1961	Change
Buick	V-8	2 bbl.	....	8.8	....	....	155	....
	V-8	2 bbl.	9.0	9.0	....	235	250	+15
	V-8	2 bbl.	10.25	10.25	....	325	325	....
	V-8	4 bbl.	10.25	10.25	....	325	325	....
Cadillac	V-8	4 bbl.	10.5	10.5	....	325	325	....
Chevrolet	6	1 bbl.	8.25	8.25	....	135	135	....
	V-8	2 bbl.	8.5	8.5	....	170	170	....
	V-8	4 bbl.	9.5	9.5	....	230	230	....
	V-8	4 bbl.	9.5	9.5	....	250	250	....
	V-8	3, 2 bbl.	9.5	9.5	....	280	280	....
	V-8	4 bbl.	11.0	11.0	....	305	305	....
	V-8	4 bbl.	11.25	11.25	....	320	320	....
	V-8	3, 2 bbl.	11.25	11.25	....	335	335	....
Corvair	6	2, 1 bbl.	8.0	8.0	....	80	80	....
	6	2, 1 bbl.	....	8.0	....	....	98	....
Chrysler	V-8	2 bbl.	....	9.0	....	....	265	....
	V-8	2 bbl.	10.1	10.0	−0.1	305	305	....
	V-8	4 bbl.	10.1	10.1	....	350	350	....
Comet	6	1 bbl.	8.7	8.7	....	90	85	−5
	6	1 bbl.	....	8.7	....	....	101	....
Dodge Dart	6	1 bbl.	8.5	8.2	−0.3	145	145	....
	V-8	2 bbl.	9.0	9.0	....	230	230	....
	V-8	4 bbl.	9.0	9.0	....	255	260	+5
	V-8	4 bbl.	....	9.0	....	....	305	....
Dodge Lancer	6	1 bbl.	....	8.2	....	....	101	....
	6	1 bbl.	....	8.2	....	....	145	....
Dodge	V-8	2 bbl.	10.0	9.0	−1	295	265	−30
	V-8	4 bbl.	10.0	10.0	....	325	325	....
	V-8	2, 4 bbl.	10.0	10.0	....	330	330	....
De Soto	V-8	2 bbl.	10.0	9.0	−1	295	265	−30
Ford Falcon	6	1 bbl.	8.7	8.7	....	90	85	−5
	6	1 bbl.	....	8.7	....	....	101	....
Ford	6	1 bbl.	8.4	8.4	....	145	135	−10
	V-8	2 bbl.	8.8	8.8	....	185	175	−10
	V-8	2 bbl.	8.9	8.9	....	235	220	−15
	V-8	4 bbl.	10.0	9.6	−0.4	300	300	....
	V-8	3, 2 bbl.	9.6	9.6	....	310	330	+20
Imperial	V-8	4 bbl.	10.1	10.1	....	350	350	....
Lincoln	V-8	2 bbl.	10.0	10.0	....	315	300	−15
Mercury	6	1 bbl.	....	8.4	....	....	135	....
	V-8	2 bbl.	8.9	8.8	−0.1	205	175	−30
	V-8	2 bbl.	8.5	8.9	+0.4	280	220	−60
	V-8	2, 4 bbl.	10.0	9.6	−0.4	310	300	−10
Oldsmobile	V-8	2 bbl.	....	8.75	....	....	155	....
	V-8	2 bbl.	8.75	8.75	....	240	250	+10
	V-8	4 bbl.	9.75	10.0	+0.25	315	325	+10
Plymouth	6	1 bbl.	8.5	8.2	−0.3	145	145	....
	V-8	2 bbl.	9.0	9.0	....	230	230	....
	V-8	4 bbl.	9.0	9.0	....	260	260	....
	V-8	4 bbl.	10.0	9.0	−1	305	305	....
	V-8	2, 4 bbl.	10.0	10.0	....	310	330	+20
Pontiac Tempest	4	1 bbl.	....	8.6	....	....	110	....
	4	1 bbl.	....	8.6	....	....	130	....
	4	1 bbl.	....	10.25	....	....	120	....
	4	1 bbl.	....	10.25	....	....	140	....
	4	4 bbl.	....	10.25	....	....	155	....
	V-8	2 bbl.	....	8.8	....	....	155	....
Pontiac	V-8	2 bbl.	8.6	8.6	....	215	215	....
	V-8	2 bbl.	10.25	10.25	....	283	283	....
	V-8	4 bbl.	10.25	10.25	....	303	303	....
	V-8	3, 2 bbl.	10.75	10.75	....	318	318	....
	V-8	4 bbl.	10.75	10.75	....	333	333	....
	V-8	3, 2 bbl.	10.75	10.75	....	348	348	....
Rambler	6	1 bbl.	8.0	8.0	....	90	90	....
	6	1 bbl.	8.7	8.7	....	127	127	....
	6	2 bbl.	8.7	8.7	....	138	138	....
	V-8	2 bbl.	8.7	8.7	....	200	200	....
	V-8	4 bbl.	8.7	8.7	....	215	215	....
	V-8	2 bbl.	8.7	8.7	....	250	250	....
	V-8	4 bbl.	9.7	9.7	....	270	270	....
Studebaker	6	1 bbl.	8.3	8.5	+0.2	90	112	+22
	V-8	2 bbl.	8.8	8.8	....	180	180	....
	V-8	4 bbl.	8.8	8.8	....	195	195	....
	V-8	2 bbl.	8.8	8.8	....	210	210	....
	V-8	4 bbl.	8.8	8.8	....	225	225	....
Valiant	6	1 bbl.	8.5	8.2	−0.3	101	101	....
	6	4 bbl.	....	8.2	....	....	148	....

Those '61 Cars

- The squeeze is still on for higher octanes but . . .
- The weighted average compression is down as . . .
- Detroit introduces 15 new compact models.

Gene T. Kinney
East Coast Editor

THE ECONOMY trend which abruptly halted the dizzying horsepower race this year is even more pronounced in the 1961 automobiles which have just hit dealer showrooms.

The spectacular success of the 1960 compacts—30% of the U. S. market, including imported cars—assures further emphasis by Detroit in this direction. And the little cars are expected to grab upwards of 40% of the 6,000,000-car market in 1961. They are being beefed up to meet public demand for performance with economy.

Joining the little compacts this year will be a new family of "medium-size" compacts and new economy models introduced by some of the higher-priced makes. Because of their impact, the weighted average compression ratio will decline from about 8.9:1 to an estimated 8.6:1, based on sales forecasts.

But there is little or no backing off in compression ratios, horsepower, or engine displacement in the higher-priced autos, although they will comprise a declining share of the market.

While the economy models will be dominant, and all claim to be designed to burn regular gasoline, there will be no rest for the refiner. Paradoxically, the outlook is for increasing pressure on regular and on super premium of 101 Research Octane Number or higher.

A study of the 1961 cars also discloses these significant developments:

. . . **The greaseless,** or nearly greaseless car is well on the way. Ford Motor Co. is coming out with suspension and steering systems prelubricated at the factory with a molybdenum disulfide-based lube good for 30,000 miles or 2 years. Cadillac has a greaseless chassis, and there are fewer grease fittings on Buick and Oldsmobile.

. . . **Longer lube-oil change** intervals are recommended by manufacturers. Suggested change is from 2,000 to 6,000 miles, and crankcases are

Will Give Refiners No Rest Next Year

smaller, pointing to an impact on sales of this product.

... **Ceramic-lined mufflers,** guaranteed for as long as the original owner drives his car, are standard equipment on the Rambler.

... **A smog-reducing device,** to circulate crankcase vapors to the carburetor so they can be consumed with fuel, will be installed on all new cars for delivery to California. But this move is not expected to be without problems, as fouling from sludge is likely to make servicing necessary.

... **Aluminum engines,** appearing only in one model last year, are used in several this year. This weight-saving move is expected to be widespread within 5 years.

... **The first 4-cylinder** car since the Henry J. bowed out in 1954 has made its appearance. It is the Pontiac Tempest.

On the negative side, the widely heralded fuel injection and ram induction have failed to overcome price resistance and catch on with auto buyers. Also, nothing of importance has been reported to project new types of power plants—the free piston, gas turbine, or electric motor—into the picture in the next few years.

Small compacts beefed up . . . Catering to the demand for additional performance, manufacturers are offering more powerful engines on the little compacts, either as standard or optional equipment.

So Detroit has a minor horsepower race started.

The Falcon, a smash success with 7% of the U. S. market and 30% of Ford sales last year, has reduced its standard 90 hp. to 85 hp. but is offering a 101-hp. option.

Corvair and Valiant, each with about 3% of the U. S. market, offered more powerful plants to supplement standard engines. Corvair came out with a 98-hp. option and Valiant, 148 hp. Valiant backed off on its compression ratio, from 8:5 to 8.2, to adjust to octane requirements.

Studebaker Lark went up in compression ratio, from 8.3 to 8.5, and in horsepower, from 90 to 112.

Ford is reported to be working on a smaller compact, the equivalent of a 4-passenger Volkswagen, with a small V-4 engine. This candidate for the world market would be built in Germany, starting perhaps in 1963.

Medium-size compacts . . . General Motors' bid for more of the economy market is represented by the Buick Special, the Oldsmobile F-85, and the Pontiac Tempest.

The Special and F-85 are powered by a new 155-hp. engine, the first V-8 made of aluminum instead of cast iron. The Oldsmobile will have available this fall a 4-barrel carburetor to boost horsepower to 185.

The Tempest is introducing the first 4-cylinder engine in 7 years in the domestic industry. It is available in packages from 110 to 155 hp., using the right-hand bank of a regular Pontiac V-8 resting at a 45° angle. The Tempest also has an optional 155-hp. V-8 from its GM sisters.

The Dodge Lancer is Chrysler Corp.'s new entry in the economy market in which it made a strong showing in 1960. The Lancer has the 101-hp. Valiant engine as standard equipment and a larger 140-hp. engine as an option.

Chrysler, De Soto, and Mercury also hopped aboard the economy bandwagon with new, less-powerful engines designed to operate on regular motor fuel.

De Soto dropped three engines in the 305 to 350-hp. range in favor of a single 265-hp. V-8, down 30 hp. from the comparable engine in 1960 and from 10.1 to 9:1 in compression ratio.

Chrysler has this same 361-cu. in. engine supplementing its regular higher-performance lines.

Mercury is out with its first 6-cylinder offering, a 135-hp. 223-cu. in. engine with an 8.4:1 compression ratio.

Powerful cars hang on . . . While the more powerful cars are losing part of their share of the market (an estimated 20% less this year), there is virtually no easing up on compression ratios and horsepower.

Also, the ultra-hot cars show no signs of fading.

Ford is introducing a 390-cu. in. Thunderbird Special V-8 with 390 hp., 1 hp. per cubic inch.

Chrysler will have its 300-G sports model, "the most powerful car in America," with its 413-cu. in. engine developing 400 hp.

What refiners face. In spite of the economy trend, and the compression-ratio plateau, refiners cannot expect less pressure on their octane pool.

The pressure will be as strong, if not stronger on regular and super premium.

This seeming paradox is explained by the scrappage of old low-requirement cars, the increased percentage designed for top regular octanes, and the addition of top-requirement cars to the population.

In 1958, slightly more than 50% of the cars were built for premium. Last year, 35% were built for premium, and this year, it is estimated that only 25% of the cars sold will require premium.

What refiners are concerned with is the percentage of cars which are satisfied with a given octane number. At the first of 1960, roughly 65% of the car population was satisfied by the average regular gas at trace-knock level. Some 80% got along on regular at the light-knock level, which is more significant to the motorist.

If refiners wish to continue to satisfy the same percentage of cars with regular, they will have to boost regular octanes about 0.6 Research Octane Number a year from the present level of 92.5, according to estimates by various industry sources.

The premium RON, reported at 99.3 in the September Ethyl Corp. nation-wide survey, would have to rise about 0.5 per year to meet hot-car needs.

Detroit is taking advantage of the higher octanes—particularly in regular—to design "up" the economy models, which exerts pressure on refiners to raise the octane number. And when refiners push up octane, they give the designer another margin to work on.

At the beginning of this year, just over half of the 60,000,000 cars on the road were of 1946-55 vintage. It is estimated that 19 million of these older, low-requirement cars will be scrapped during the next 5 years. While almost 4,000,000 per year of these old cars are being retired, new cars with higher octane appetites will be added at the rate of 6,000,000 per year.

Although a declining percentage of the new cars will be in top compression ratio and horsepower range, an increasing percentage of cars on the road will require super premium in the next several years.

It's estimated that anywhere from 2.5% to 5% of present cars can use super premium. And, depending on sales, some 12 to 15% of the new cars sold this year will require the highest octanes available, thus keeping the refiner's feet to the fire, although the horsepower race is—for the time being—over.

It's an odd state of affairs, but there's . . .

Too Little Crude, Too Much Product

- And the Texas Railroad Commission is asking the majors: Since you have more product than you've said you need, why do you want more crude? Some oil men are betting Texas will stay on 8 days again next month.

THE strange spectacle of continued heavy refinery runs in the face of tightened supplies of crude will get the attention of the Texas Railroad Commission at its October 20 meeting in Austin.

This became apparent last week when Gen. Ernest O. Thompson of the commission confirmed that the agency had sent a questionnaire to more than 20 major oil firms asking specific data on their operations.

Thompson labeled the questionnaire as "routine procedure" used by the commission to develop information to guide it in setting monthly crude-production allowables for Texas.

He said the companies were asked for figures on:

. . . **Level of crude** and four-product inventories they consider desirable as of October 1.

. . . **Actual inventories** of these held by each on October 1.

. . . **Complete refinery runs** for all plants nationwide for September.

. . . **Per cent of capacity** these runs represented on October 1.

Thompson said the information would be developed during questioning of oil-company representatives at the October 20 hearing. The commission does not plan to compile the data prior to the hearing.

The market . . . Crude is in short supply and getting scarcer.

Crude buyers attribute the condition to the 8-day allowable policy pursued by the Texas commission for several months. Several majors also told the Journal privately last week they think the commission will hold to the 8-day level for November. They pointed to continued high level of refinery runs and subsequent high products stocks as supporting this belief.

Crude stocks are about 21,000,000 bbl. too low and major-product stocks 55,000,000 bbl. too high (OGJ, Oct. 3, p. 164). These estimates are based on previous reports by the companies on the desirable levels of these commodities for October 31.

Motive behind Thompson's latest request for inventory data apparently is to determine if the companies have changed their ideas on what levels are desirable and to find out, if possible, why they are running so much crude to products.

A few refiners have publicly announced they plan to cut back crude runs in the fourth quarter. Others say privately they plan to run only the amount that demands of their own markets dictate.

Nearly all deny individually they are running too much crude beyond their own needs. Yet, collectively, the products resulting from the runs exceed levels the same companies have told the commission are desirable for demand usually existing at this time of year.

Crude picture . . . Upshot of the tight grip the commission has kept on Texas crude production is a firm price tone to the crude market.

Sloppy price areas have disappeared. Prices have moved up in a few areas, notably Kansas and the Illinois basin.

Discounting of crude also has practically disappeared. One buyer who surveyed the market last week looking for crude reported the only discounts he heard were tied to contracts.

One firm reported it had been getting South Louisiana crude from selected pools at a discount on a short-term contract. When this contract expired recently, the buyer quickly agreed to pick up the crude at full posted price.

Many refiners reportedly have dipped into their inventories of crude to keep their refineries running at high levels. The economic reasoning: It's cheaper to carry the inventory as products than as crude because of savings derived from high-level refinery operations.

Effect on products . . . Product markets have been static for several weeks, with most sellers holding to see which way prices are going.

The gasoline market is practically in a stalmate, very little is moving. Prices have kept close to posted levels, due in part to a few interrefinery deals several weeks ago which put material in the hands of people who can afford to hold.

One sale below posted price was reported on the Gulf Coast last week when a major sold a supertanker of 100-RON gasoline to a West Coast buyer for one-half cent off posted. There were reports, however, that the material was unfinished product and was intended for blending to upgrade the West Coast refiner's gasoline.

The heating oils need cold weather to start any major movements. Inquiries naturally have been picking up, and prices have remained firm. Demand soon will determine which way they go.

The danger of carrying heavy product inventories naturally lies in the possibility that some refiner may need the storage space or need to convert the products into cash and will start offering discounts to move them.

The word spreads, and before long everyone is discounting. Refinery realizations decline, and the pressure is then on the price of crude.

This inevitable link between high product inventories and crude prices is behind the current interest being shown by the Texas Railroad Commission.

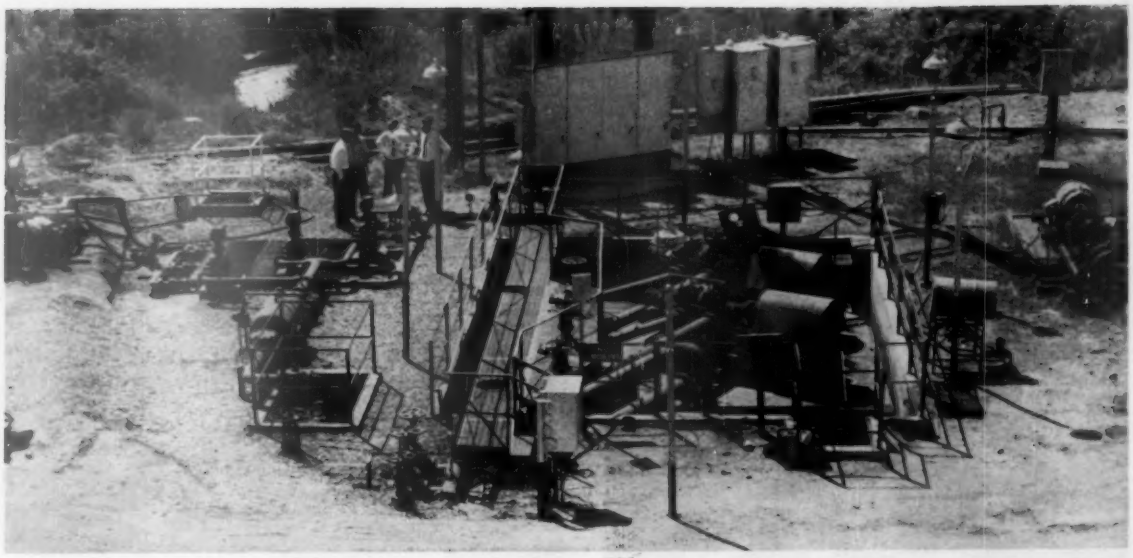
Same Old Story

THE refiners' supply-demand picture didn't get any brighter last week.

Stocks of major products jumped 5,925,000 bbl. during the week ended September 30, an abnormal gain for that time of the year.

Refinery runs for the week averaged 7,949,000 bbl. daily—down 14,000 bbl. from the previous week but 331,000 bbl. above the same week a year ago.

For the month of September, this is the picture: Total demand averaged about 9,100,000 bbl. daily, down 300,000 bbl. from September 1959. Refinery runs averaged 8,075,000 bbl. daily, up 200,000 bbl. daily from 1959.



PRODUCTION from Shell's top producer in the U. S. (Ventura Avenue field) is handled by LACT.

Giant LACT Unit Pays Off for Shell

• The company is expanding its lease automatic custody transfer systems on the West Coast and is happy with its 22,000-bbl. unit in Ventura Avenue field.

SHELL OIL CO. has what is believed to be the biggest lease automatic custody transfer unit in the oil patch on its Taylor lease in Ventura Avenue field in Ventura County, California. And the company figures that LACT unit paid for itself the day it went on stream.

The Ventura Avenue system handles 22,000 bbl. of crude daily from over 500 wells. The system has a design capacity of 36,000 bbl. daily (1,500 bbl. an hour), but this added capacity is built into the unit as standby capacity in case of a shutdown of one of the three metering systems.

The quick payout is based on the premise that this unit eliminates the need of keeping 15,000 bbl. of crude in storage on the lease. This inventory of oil was worth $41,000, which is almost double the $23,000 it cost to install the LACT unit. And eliminating the inventory removed the need for most of the tank farm.

Shell's faith in LACT was obvious when it put the system on the 1,500-acre Taylor lease. The lease is Shell's biggest producer.

The Ventura Avenue system is one of 26 LACT installations Shell will have in operation in its Pacific Coast area by the end of the year. The units will meter 48,000 bbl. of crude daily. Throughout the country, Shell will have 99 units handling 112,000 bbl. of crude by the end of the year.

The big system has been operating smoothly at Ventura Avenue for 6 months. It was designed and installed under the supervision of S. G. Wiles, division mechanical engineer.

Even a bigger saving would have been made if the Taylor lease unit had been built when the lease was originally set up rather than converting the lease to LACT. This added saving would result from using less tankage than is used with the converted system.

Shell is using two 20,000-bbl. tanks for storage on the lease. One of the tanks is standby storage but, this 20,000 bbl. working storage itself is more than would normally be used if the lease had been started as an LACT lease. The two 20,000-bbl. tanks are part of the old tank farm, which also included two 10,000-bbl. tanks taken out of service.

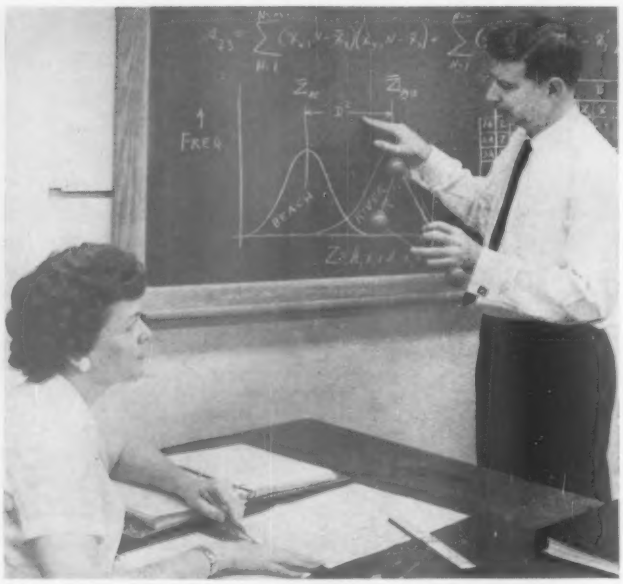
LACT experience . . . Much of Shell's faith in LACT is founded on the success the company has had with LACT in the Four Corners area.

Shell has nine units operating in Bisti and Aneth fields—and has moved 9 million barrels of crude in the units with a cumulative error of only 0.01%.

Accuracy of the meters on the Four Corners leases is maintained through monthly checks made by Four Corners Pipeline Co., the pipeline which moves the crude to the West Coast.

ONE of the three meters on LACT unit at Ventura Avenue is checked by Watt Lupton, left, district superintendent, and L. F. Romalho, district gager.

No cost figures have been released on just what Shell is saving in the way of operating costs at Ventura Avenue, but a study of the Four Corners operations shows the producer is saving $4,800 a year per installation and the pipeline $10,260 a year per installation.



ABOVE: Research sedimentationist, Dr. J. C. Ludwick, Jr., interprets data from a computer-prepared tabulation as an assistant, Miss J. M. Allen, dictates material. The computer system makes the geologist more important than ever, as no machine can pin down a location.

LEFT: A key step in computer processing of exploration data is the mechanical punching of IBM cards with information obtained from an automatized X-ray diffractometer. Shown are mineralogist A. C. Lilly, Jr. (foreground), and stratigraphic mineralogist W. F. Hooper.

Will Computers Click as Oil Finders?

• It's obvious that machines can process exploration data faster than humans. But researchers still have to prove two things: That computers can knock down oil-hunting costs and that their use will be practical.

Gene T. Kinney
East Coast Editor

COMPUTER PROCESSING of exploration data is beginning to look like one answer to the industry's need to cut oil-finding costs.

Several companies are studying the advantages of machine processing and manipulation of large masses of data to help evaluate a drilling prospect. Efforts in this direction are largely in the research stage.

But at least one company—Gulf Oil Corp.—has seen enough to be optimistic that computers will soon become useful oil-finding tools.

Gulf Research & Development Co. has spent 4 years in setting up a computer data-handling system. Large-scale pilot programs are now under way, as an adjunct to conventional methods in field and laboratory, to determine how and where new techniques will fit into a regular exploration program. In 1 to 2 years, Gulf expects to have a good idea as to their practical value.

But before the verdict is in, exploration scientists at Gulf Research Center, Harmarville, Pa., are willing to make claims that at first seem extravagant, even by computer standards, such as:

. . . **This computer system** could multiply the effectiveness of exploration geologists by thousands of man-hours per year.

. . . **It could advance** the knowledge of petroleum geology 20 years in a single leap.

. . . **It could manipulate** more geological data in 1 year than geologists have handled manually in the past 150 years.

. . . **Most important of all,** it could reduce the cost of finding oil by giving the geologist more complete and precise data on which to base decisions.

The geologist now is able to assemble and study only a small percentage of the data he really needs to explore for oil. With computer handling, great masses of information usually discarded for lack of processing time can be made available. And it will be in a form that is more useful for interpretation.

Computer system . . . The first step was to adapt data-collecting and recording methods to permit machine handling.

A code language was created with components of words and sentences which could be recorded and individually manipulated as desired. Components were translated into dots, magnetic pulses, and punch holes in an IBM card system.

Properties of geological specimens

ANALYSTS study a compositional log compiled from field and laboratory studies of rock samples as it leaves the computer's printer. Watching are J. E. Fedako, computer analyst, left; Dr. H. A. Boyd, Jr., stratigrapher; and J. M. Cattley, ananlyst.

NEWLY DEVISED data-processing method developed at Gulf Research Center is reviewed by Dr. L. J. Peters, vice president, and Georges Pardo, project director, of Gulf Research and Development Co.

were represented by coded position points on cards.

Under present methods a geologist may spend up to 50% of his time classifying, recording, and presenting data in usable form. Under the new Gulf method the entire system, except for rock-sample preparation, is automated.

A geologist working with an X-ray machine can identify mineral components of about 20 samples per day, without automatic handling. Gulf feeds slides into its own automatized X-ray machine, permitting the geologist to do 10 times as much work. The machine not only analyzes the sample but also records its properties on punch cards.

Run through the computer, the rocks are identified by machine much as a geologist does the same job.

The computer also takes over the onerous drafting chores. It needs only 3 hours for work which would take a draftsman 18 months in transferring oil-well data from sheets to a printed graph.

When rock properties have been coded and recorded on cards, the code can be reconverted to abbreviations or tabulations in printed form from which the geologist can make his interpretation.

Cost . . . Can such an operation be made economical, or is it a luxury that an exploration department cannot afford?

A large computer, the equivalent of an IBM 704, is required for some of the more sophisticated research operations. However, Gulf is attempting to reduce the process for operating purposes so that small computers or tabulating equipment can do most of the job.

Gulf has added no computers for this particular project. Available machines in the research and operating departments have been sufficient. More sorters and key punchers are needed for data manipulating, but these are minor cost items.

Coding is not cheap, but it turned out to be less trouble than was expected.

Results . . . The introduction of automation into exploration has been some cause for alarm on the part of the troubled geologist, who temporarily finds his skills in less demand in this period of oil surplus.

But Gulf experience tends to reassure him. Such a computer system should make the competent geologist more important than ever. For the machine cannot pinpoint a location—it puts the geologist in the best possible position to do so.

Heretofore, a geologist has had to make decisions based largely on his own experience, which is necessarily limited. Having available a large mass of data will have the effect of expanding his experience by several orders of magnitude.

Freed of routine clerical work, the geologist has more time for interpretation and planning. It is the exploration version of the computer story often repeated elsewhere in industry; the professional's scope is enlarged by removing drudgery from the job and by providing more significant decision-making information than has been available before.

CHEMICAL DATA needed to complete the geological picture of an area is obtained by G. J. Schrayer, Jr., organic geochemist.

OCAW Faces Baytown Revolt

. . . from independent union it unseated at Humble refinery. Petition signed by 1,200 workers asks new election.

THE Baytown Employes Federation is making a major comeback effort.

The independent union had, for a generation, represented employes of Humble Oil & Refinery Co.'s big Baytown, Tex., plant, but it suffered a surprising defeat in August, 1959, at the hands of the Oil, Chemical & Atomic Workers Union.

The OCAW subsequently negotiated a contract with management, effective last February.

The BEF, meanwhile, has continued to represent about 300 clerical workers at the refinery and 80 other employes at the special products plant and fuel-oil terminals at Houston. It has retained its headquarters and organizational setup despite the fact that it no longer represents the bulk of refinery employes—about 3,300 production and maintenance workers.

Last week the BEF had succeeded in obtaining about 1,200 signatures of employes asking for a new bargaining agent election. The National Labor Relations Board will rule on the petition and, if the signatures are sufficient, call the election. Thirty per cent of the affected employes must sign the petition.

Complaints . . . R. L. Potter, president of the BEF, said there has been "dissatisfaction and disappointment" in the handling of union affairs by the OCAW.

"The OCAW promised a lot and didn't deliver," Potter said. "The contract they negotiated was just a blank check to management."

The BEF, he added, has asked for a 25-cents-per-hour raise for the employes it represents. The request was turned down at the refinery and is now before a higher management level. Also the BEF is asking new fringe benefits, including a guaranteed salary for the last 5 years of an employe's worklife and a larger discount on plant products for employes.

OCAW position . . . J. B. Coulter, president of the OCAW local at Baytown, said he is confident the international union can beat off any attempt of the independent union to win a bargaining agent election.

Coulter conceded there has been some dissatisfaction among workers at the refinery but said it stems from "problems that we inherited." The basic cause of the trouble involves job security.

"We couldn't solve all these problems in one contract," he said.

While negotiations for a new contract will not open until later, the OCAW expects to move quickly for higher wages. The union's national policy calls for an increase of 18 cents per hour across the boards.

When the OCAW won the bargaining agent election last year, the victory was considered a surprise. It represented the first breakthrough of an international union in one of the Standard Oil Co. (N. J.) refineries. The vote was 1,621 for the OCAW to 1,196 for the BEF (OGJ, Aug. 17, 1959, p. 96).

The BEF and other independent unions at Jersey-affiliated refineries had a history going back some 40 years.

Other areas . . . The OCAW headquarters in Denver, reporting to membership on the industrywide wage drive, disclosed that no oil company yet has made an offer to increase wages.

The union spokesman said that companies continue to "stall off a showdown or to complain about profit levels."

At Perth Amboy, N. J., operating engineers and construction laborers called off a strike at the California Oil Co.'s 123,000-bbl. daily refinery. They voted 415 to 107 to accept a revised company offer.

The new 1-year contract calls for minor wage adjustments in two job classifications, better distribution of vacations, and other benefits.

Low Alberta Allowable Set

CRUDE-OIL production in Alberta this month will be at the lowest level of the year.

The October allowable was set at 299,175 bbl. daily with an additional 9,400 bbl. daily for condensate.

This will be the first time this year that production has dipped below 300,000 bbl. daily, figuring on a monthly basis.

The October rate is only 34% of Alberta's potential. Crude-oil output for the month will be 11% below the estimated economic allowance for the province.

Alberta's Oil and Gas Conservation Board reported adjusted potential was 876,000 bbl. daily at the end of September. It also gave an estimate of 337,168 bbl. daily on the economic allowance.

The allowable for October is a drop of 48,840 bbl. for crude oil in September, but an increase of 1,800 bbl. in condensate production.

New Gulf Move

. . . transfers its traffic department to Houston.

GULF Oil Corp. has taken another step to consolidate its operating headquarters in Houston.

Gulf Refining Co., which manages Gulf's domestic pipelines at Houston, will take over the parent company's domestic traffic department previously headquartered in Pittsburgh. This includes movement of oil by barge and common carriers.

The barge operations consist of gathering crude in the Gulf of Mexico and delivering products from the Port Arthur, Tex., refinery.

In the past year Gulf has moved the operating headquarters of its production, manufacturing, and marketing departments to Houston.

Gulf Refining is headed by J. L. Irvin. Walter L. Shannon, director of pipeline engineering at Pittsburgh, will move to Houston to become manager of domestic pipelines.

William M. Johnson, now in Pittsburgh, will become general traffic manager in Houston. Arthur Ernst, manager of barge transportation, also is moving from Pittsburgh to Houston.

INDUSTRY

Ohio Oil Co. has bought all Kinney-Coastal Oil Co. properties for $1,629,000 in cash plus an oil and gas production payment of $7,300,000 which will be spread over a 7-year period. Kinney-Coastal net production totals about 2,300 bbl. of oil daily, mostly from Garland field in Wyoming's Big Horn basin.

Nordon Corp., Ltd. has acquired the California properties of Barret-Bysshe and Cleveland Oil Co. Involved were 60 wells producing an average of about 600 gross barrels of 14 to 35°-gravity oil per day and reserves estimated at about 5 million barrels of oil.

Stockholders of Standard Oil (Ind.) have overwhelmingly approved a proposed corporate reorganization which is expected to take effect December 31. The go-ahead is subject to final

Service Station Fixup Urged

. . . by city planner. He suggests creation of standards to prevent eyesores and razzle-dazzle advertising.

A LEADING city planner last week called on gasoline marketers to develop standards for service stations that would eliminate ugly architecture and blatant advertising.

Allen Fonoroff of the Cleveland city planning commission spoke before the operations and engineering committee of the American Petroleum Institute at Houston.

The committee is studying, among other things, proposals for improving the appearance of service stations.

Fonoroff suggested that oil industry take the initiative in bringing together its own experts and city planners to organize a joint study program aimed at setting standards acceptable to both groups.

The chief prejudice against service stations, Fonoroff said, stems from the "aesthetic nuisance."

"Too many service stations are eyesores," he said, "and their ugliness detracts from the neighborhood.

"They are ugly because of their poor taste in architecture, loud and indiscriminate forms of advertising, outdoor storage and display of products and small trailers, and a general appearance of disorder."

This, of course, is not a condemnation of all service stations. Some are very attractive and are operated in good taste.

"However, enough stations fit this description of ugliness to create a general impression," he said

Advertising displays of some service stations were described by Fonoroff as "activated billboards."

"Too many service stations have developed into a tremendous grab for the motorist's attention," he said.

"The design of service stations should minimize the need for large signs, streamers, and other garish features that may disfigure a neighborhood. Tasteful design and general appearance should represent a certain intangible value—if not in terms of dollars, then certainly in terms of good will."

Fonoroff said the oil industry and city planners need to cooperate in solving two basic problems: Where stations should be located in a community, and how the sites should be developed.

Carbon-Black Plant Planned

UNITED Carbon Co., Houston, will build a $5 million carbon-black plant in southern California with a 64,000,000-lb. annual capacity.

The plant will provide carbon black for tire and rubber goods manufacturers in the Pacific Coast area. Carbon black now is shipped from plants in the south and southwest.

Completion of the new plant is scheduled for late 1961.

United Carbon operates six carbon black plants in the U. S. and makes carbon black in Australia and in the United Kingdom. It will complete a plant in France early next year.

The company also operates the world's largest synthetic-rubber plant for making black masterbatch.

Atlantic Search

. . . for oil begins as Kermac launches survey.

A SEISMIC survey of the Atlantic Ocean floor off New Jersey is being conducted by Kerr-McGee Oil Industries Inc., Oklahoma City.

Kermac obtained permission from the U. S. Geological Survey to explore the continental shelf beyond the 3-mile limit, outside state jurisdiction.

It had been announced by the Interior Department earlier that oil firms could make geological and geophysical explorations off the coast of any state bordering on the Atlantic.

Kermac also has authority to conduct seismic operations off New York, Delaware, Maryland, and Virginia. If initial surveys are promising, the company will seek leases.

Kermac is shooting some 10 to 30 miles off the Jersey coast in what is believed to be the first such exploratory program in this area of the Atlantic.

BRIEFS . . .

review by Standard's board of directors. More than 88% of the company's 35,100,000 outstanding shares were voted for the reorganization, with less than ⅓ of 1% being voted against it.

Two more wells have been completed in the town-lot drilling program being carried out by Signal Oil & Gas Co. and Richfield Oil Corp. in West Los Angeles. The two new wells bring the total in two adjoining town-lot drill sites to 16 and push daily production to 5,200 bbl. Signal, operator, has one rig drilling on Rancho golf course and another at Hillcrest Country Club. Since October 1958 the two leases have produced 1,200,000 bbl. of oil and 4,000,000 M.c.f. of gas.

Sawyer Petroleum, Los Angeles, has purchased controlling interest and taken over management of Capital-Seaboard Corp., a Texas firm. E. W. Sawyer Jr., head of Sawyer Petroleum, will become president of Capital-Seaboard. The Texas firm operates 26 producing wells in Jack, Wise, Archer, and Young counties and a natural-gasoline plant with a daily capacity of 2,000 M.c.f. The purchase price included cash, Sawyer stock, and assignment of 15,000 acres of leases.

An instruction program aimed at providing better service and management in service stations has been launched by Monsanto's Lion Oil Co. division. Four dealer service representatives will counsel station operators throughout Lion's retail marketing area in nine southern and midwestern states.

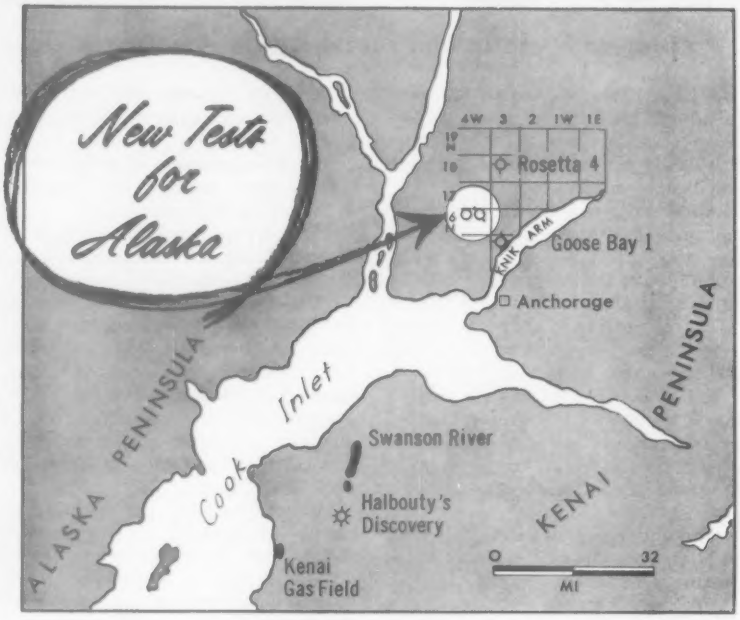
In a transaction that would involve $14.8 million in cash, Felmont Petroleum Corp. has contracted to sell Cities Service all of its producing leasehold properties in the U. S. and Canada except those located in the Gulf of Mexico and in the Appalachian basin area. Sale hinges on approval by those holding a majority of Felmont Petroleum's shares at a December meeting.

LPG underground storage facilities of Esso Standard at Sorrento, La., are being expanded by 350,000 bbl. One new cavity will be drilled in the salt-dome formation 3,000 ft. beneath the swampy site 35 miles south of Baton Rouge. It will be used to store propane and will boost total capacity of Sorrento storage to 1,820,000 bbl. The $380,000 expansion will be finished in about 10 months.

A proposed merger of Alberta Pacific Consolidated Oils Ltd. with Savanna Creek Oil and Gas Ltd. has been rejected by Alberta Pacific directors. The turndown followed a special survey of the two companies.

Alaskan Test Spudded by Union and Ohio

• Two firms start search on Knik Arm acreage north of Kenai Peninsula.



UNION Oil Co. and Ohio Oil Co., two companies which have shared in all but one of Alaska's wildcat successes, have launched a new wildcat program aimed at establishing production in another area of the state.

Union, operator for the two companies, has spudded the Knik Arm 1, about 18 miles northwest of Anchorage in Sec. 2-16n-4w. Location has been staked for a second well in Sec. 5-16n-4w. Projected depth for both wells is 3,000 to 3,500 ft.

The two companies hold a 4-year development contract on about 229,000 acres in this area, which is north of the Kenai Peninsula. The contract calls for the companies to spend $450,000 and drill three exploratory wells before it expires in 1963 (OGJ, Feb. 23, 1959, p. 77).

The Knik Arm test falls about halfway between two dry holes drilled in this area of Alaska during the last 5 years.

Anchorage Oil & Gas Co. drilled a series of dusters in the Susitna Flats area 10 miles to the northwest. The last well, Rosetta 4, was suspended in 1958 at 6,068 ft. About 5 years ago, Alaskan Gulf Oil Co. drilled its Goose Bay wildcat to below 4,000 ft. about 7 miles to the southwest of the Union-Ohio test.

Union and Ohio are among the few companies that have turned their Alaskan operations into what looks like a paying proposition.

The two companies have completed three gas wells on their Kenai unit holdings about 150 miles southeast of the new wildcat play. And each holds 5¼ % interest in the Swanson River unit being developed by Standard Oil Co. of California and Richfield Oil Corp. Alaska's only commercial oil field, Swanson River field, is located partly on the unit (OGJ, Sept. 19, p. 72).

A gas line is being laid to Anchorage from the Union-Ohio wells in Kenai unit and the companies are preparing to start a development drilling program in the field. Location is being graded for the Kenai unit 13-4 in Sec. 4-4n-11w and three other locations have been staked.

The only Alaskan discovery in which Union and Ohio don't have an interest is the gas strike made last month on the Kenai Peninsula by Michel T. Halbouty, Houston independent (OGJ, Oct. 3, p. 70).

Other wildcats . . . The Knik Arm test is one of three wildcats making hole in Alaska.

Tri-City Drilling Co. has the contract for the Union test. The contractor is preparing to set surface casing to about 500 ft.

Colorado Oil & Gas Co. is drilling at 6,500 ft. on the Dangerous River 1 in the Cape Fairweather area and Richfield is redrilling at 6,150 ft. on its Kaliakh River unit 2 in the Cape Yakataga area.

Alaska Crude Line Finished

. . . by California Standard affiliate. It's the first time Alaskan crude has started to market via pipeline.

ALASKAN crude oil is moving through a pipeline for the first time. It's on the way to a California market.

Kenai Pipe Line Co., an affiliate of Standard Oil Co. of California, has completed its 22-mile 8-in. line from Swanson River field on the Kenai Peninsula to Nikiski, a small town on Cook Inlet. The flow of the crude marks the beginning of a payout for the millions poured into developing commercial oil production in Alaska (OGJ, Sept. 19, p. 72).

The pipeline will have an initial capacity of 10,000 bbl. daily, but only about half this amount is expected to be moved since the field is capable of producing only 5,500 bbl. daily from 11 wells.

The first tanker of crude will probably be delivered to Richfield Oil Corp.'s Watson refinery in Los Angeles. Future deliveries probably will be split between Richfield and Socal, the two major owners of Swanson River field.

Prices posted . . . Standard of California has posted its first prices for the Kenai crude.

The prices are considerably below other domestic postings, but the company pointed out the crude will be at about the same level as California postings when transportation costs from Alaska are added.

The postings run from $1.88 a barrel for 25-25.9° crude to a top of $2.76 a barrel for 40-40.9° crude.

The Kenai crude averages about 30° gravity. The posting for 30-30.9° is $2.21.

Motor-Fuel Use to Rise 3.6% This Year

HIGHWAY USE of all types of motor fuel this year will be up 3.6% over 1959, and nonhighway use also will rise.

These predictions were made last week by the U. S. Bureau of Public Roads.

Together, highway and nonhighway use of fuels will account for 63.8 billion gallons. This includes 58.3 billion for highway use and 5.5 billion for nonhighway use.

Total increase in motor-fuel use will be less than the 4.8% gain made last year over 1958. It will be generally less than the average annual gain since the end of World War II.

Of the highway use, the bureau estimates that 55.8 billion gallons will be gasoline and 2.5 billion gallons will be other fuels, such as diesel and butane.

The highway use will average out to about 790 gal. per vehicle registered during 1960.

The bureau compilation shows that California leads all states in motor-fuel consumption, burning an estimated 5.7 billion gallons this year on its highways. Five other states—New York, Texas, Pennsylvania, Ohio, and Illinois—are expected to use more than 3 billion gallons each.

These six states, together with Michigan and New Jersey, will account for 47% of the nation's highway-use total.

However, the states showing the biggest percentage gain over 1959 are Arizona and Hawaii, with increases of 8.1% and 8.0% respectively.

States expected to consume between 1 billion and 2 billion gallons each include Alabama, Florida, Georgia, Indiana, Iowa, Massachusetts, Minnesota, Missouri, North Carolina, Tennessee, Virginia, and Wisconsin.

The bureau made its estimates on the basis of state reports of motor-fuel consumption in the first months of this year. Also used in the forecasts was information on current trends, motor-fuel production and other factors.

Preliminary Estimate of 1960 Highway Use

(In thousands of gallons)

State—	Gasoline	Special fuel	Total	% Change	Gal. per vehicle
Alabama	968,127	36,013	1,004,140	4.6	783
Alaska	50,724	.....	50,724	5.6	676
Arizona	476,456	45,242	521,698	8.3	840
Arkansas	547,956	30,566	578,522	2.9	819
California	5,330,821	335,386	5,666,207	4.4	728
Colorado	615,340	40,121	655,461	4.8	714
Connecticut	772,320	16,650	788,970	3.1	722
Delaware	172,019	4,436	176,455	3.6	924
Florida	1,670,175	51,927	1,722,102	4.9	726
Georgia	1,270,397	65,461	1,335,858	4.1	889
Hawaii	132,358	4,263	136,621	8.0	597
Idaho	247,261	14,762	262,023	4.7	697
Illinois	2,883,613	129,259	3,012,872	3.3	797
Indiana	1,657,197	68,229	1,725,426	2.8	847
Iowa	970,086	36,602	1,006,688	2.8	760
Kansas	768,019	44,897	812,916	2.5	702
Kentucky	839,384	41,283	880,667	2.1	739
Louisiana	896,371	30,610	926,981	2.9	784
Maine	329,664	6,060	335,724	4.1	891
Maryland	877,477	29,598	907,075	3.5	794
Massachusetts	1,407,924	27,264	1,435,188	2.9	796
Michigan	2,523,382	41,298	2,564,680	4.0	776
Minnesota	1,139,791	42,069	1,181,860	4.8	754
Mississippi	632,729	26,606	659,335	3.2	912
Missouri	1,520,209	65,154	1,585,363	2.2	895
Montana	247,907	27,655	275,562	3.8	721
Nebraska	519,155	32,120	551,275	2.2	761
Nevada	142,345	20,017	162,362	7.2	944
New Hampshire	198,491	2,158	200,649	3.4	775
New Jersey	1,975,221	90,399	2,065,620	4.1	865
New Mexico	388,829	46,528	435,357	3.7	961
New York	3,781,384	90,256	3,871,640	3.4	757
North Carolina	1,424,297	55,176	1,479,473	3.5	865
North Dakota	184,432	11,238	195,670	1.6	570
Ohio	3,098,827	137,492	3,236,319	3.3	798
Oklahoma	872,577	47,721	920,298	4.3	781
Oregon	622,216	53,090	675,306	3.8	749
Pennsylvania	3,159,252	125,653	3,284,905	3.3	763
Rhode Island	246,630	6,107	252,737	2.9	741
South Carolina	717,230	27,187	744,417	4.2	810
South Dakota	242,386	12,337	254,723	2.2	722
Tennessee	1,085,759	50,660	1,136,419	3.4	866
Texas	3,609,674	189,265	3,798,939	2.9	861
Utah	293,525	28,137	321,662	4.5	766
Vermont	131,675	.....	131,675	4.4	854
Virginia	1,254,730	91,676	1,346,406	4.2	942
Washington	901,606	42,725	944,331	3.4	693
West Virginia	472,165	26,500	498,665	0.7	835
Wisconsin	1,213,074	31,870	1,244,944	3.9	782
Wyoming	161,780	20,851	182,631	4.2	904
Dist. of Col.	202,932	4,678	207,610	1.9	1,003
Total	55,847,899	2,505,252	58,353,151	3.6	790

Military, Oil Men to Talk Over Problems

MILITARY officials and oil officials meet in Washington this week to acquaint each other with their outlook and position and to discuss ways of overcoming joint problems.

The occasion is a petroleum seminar being held in conjunction with the annual national convention of the Quartermaster Association. The meeting begins Wednesday and runs through Friday, and the military is hopeful that a large number of industry representatives will attend.

The Wednesday topics will include the responsibilities of the Military Petroleum Supply Agency in military petroleum logistics, corrosion problems, the NATO pipeline system, and petroleum economics.

Thursday there will be a field trip to Fort Lee, Va., to inspect the military's petroleum-training facilities.

Friday's program will cover Military Sea Transportation Service tanker operations, the Middle East, the threat of growing Soviet petroleum production, underground storage, and how the pattern of the refining industry might be better shaped to meet military needs in an emergency.

Co-chairmen of the 3-day program are Vice Adm. Burton Biggs, director of petroleum logistics policy for the Department of Defense, and W. W. Keeler, executive vice president, Phillips Petroleum Co.

Work Let on Huge Gas Line

. . . that will move gas 1,400 miles from Alberta to California. Eight contractors share in the letting.

EIGHT PIPELINE contractors, including some who combined forces, will build the 1,400-mile system to connect natural-gas fields of Alberta with San Francisco.

More than 90% of the main line, extending from the Whitecourt, Alta., area to Antioch, just outside San Francisco, will be 36-in. That makes it one of the biggest lines ever built—even in this day of big-inch pipelining.

Contracts have been awarded in San Francisco for the U. S. portion of the line and in Calgary for the Canadian portion.

Preliminary work on right-of-way clearing has started but little mainline laying will be done this year. Some pipe will be laid in the U. S. portion and a 20-mile stretch will be laid south of the Bow River in Alberta before December 31.

Pipe deliveries have already begun on the section between California and the Canadian border. More than 50 miles of 36-in. pipe has been delivered to the welding and wrapping yard at Sprague River, Ore.

Construction of the main line is expected to take 12 to 14 months. Some time during the winter of 1961-62, close to 600 million cubic feet of Canadian gas will begin moving into the U. S. daily.

These were the successful bidders on the system:

H. C. Price Co., Bartlesville, Okla., the 291-mile Pacific Gas & Electric Co. portion from Antioch to the California-Oregon border near Malin, Ore. This consists of Sections A, 80 miles; B, 60 miles, and C, 151 miles.

Western Pipeline, Inc., Austin, and J. P. Neill & Co., Dallas, the 465-mile southern part of the Pacific Gas Transmission Co. portion. This is divided into Section 5, 156 miles from Malin to Bend, Ore.; Section 4, 157 miles from Bend to Stanfield, Ore., and Section 3, 152 miles from Stanfield to Rosalia, Wash.

H. C. Price, the 146-mile northern part of the Pacific Gas Transmission portion from Rosalia to Eastport, Idaho, on the Canadian border.

Price-Poole of Canada, Ltd., a joint venture of H. C. Price of Canada, Ltd., Calgary, and Poole Construction Co. Ltd., Edmonton, the Alberta Natural Gas Co. portion from Eastport to Crowsnest Pass on the British Columbia-Alberta border.

Majestic Contractors, Ltd., Edmonton, Section 1 of the Alberta Gas Trunk Line portion, 113 miles from Crowsnest Pass to Priddis, Alta.

Mannix Co., Ltd., Calgary, Section 2 of the Alberta Gas Trunk Line portion, 113 miles from Priddis to Rocky Mountain House, Alta.

Majestic Contractors, Section 3 of the Alberta Gas Trunk Line portion, 63 miles from Rocky Mountain House to Cynthia, Alta.

Dutton - Williams Brothers, Ltd., Calgary, Section 4 of the Alberta Gas Trunk Line portion, 62 miles from Cynthia to the vicinity of Whitecourt, Alta.

Piggott Construction, Ltd., Edmonton, Section 5 of the Alberta Gas Trunk Line portion, 64 miles of 16-in. from Crowsnest Pass to Carway, Alta., on the Canadian border.

All the main line is 36-in. except the last 125 miles of Sections 3 and 4 in upper Alberta, which is 30-in., and the lateral which Piggott will build to the border. This 16-in. line will be extended to Cut Bank, Mont.

Two laterals will be built in Alberta at the time the main line is constructed. Dutton-Williams will build a 20-mile, 22-in. line to the Whitecourt area and Majestic Contractors will put in a 38-mile, 22-in. line to the Rimbey region.

Other laterals scheduled for construction last year or later will connect Buck Lake, Carstairs, East Calgary, Wildcat Hills, Sarcee, and Berland River, Kaybob, Lovett River, Stolberg fields.

Engineering managers are Bechtel Corp. in the U. S. and Canadian Bechtel, Inc., in Canada.

The huge system will deliver gas to Pacific Gas & Electric, principal sponsor, 415 million cubic feet per day; Pacific Northwest Pipeline Corp., 151.7 million cubic feet and Montana Power Co., 30 million cubic feet.

Asphaltic-Crude Decision Near

. . . as formal arguments over their exemption from import controls end. California Standard fires last salvo.

THE STAGE is set for the Office of Civil and Defense Mobilization to make a decision on whether to free asphaltic crude content from import controls.

Argument for and against the controversial move has been going on for months, waxing hotter and hotter.

It started with the submission of a decontrol proposal by four companies—Atlantic Refining Co., Cities Service Co., Standard Oil Co. (Ind.), and Standard Oil Co. of California.

OCDM invited comments on the suggestion and received an outpouring, particularly from companies and organizations opposing the decontrol step.

Finally, OCDM provided a period for rebuttal arguments and last week California Standard submitted a lengthy one, together with supplementary arguments it had compiled after winding up a study of the opposition's arguments.

Now the problem is in the lap of the OCDM.

The basic argument of the four companies originally urging decontrol was that there is a shortage of the proper types of domestic asphaltic crudes. Their recommendation, therefore, was that importers be permitted to bring in foreign asphaltic crudes without the asphaltic content of these crudes requiring an import quota or being charged against a firm's existing crude-import quota.

They suggested that the over-all total of import allowables be trimmed

PROCESSING

Tennessee Gas Transmission Co. has gone to court with a petition to knock out a Federal Power Commission ruling that cut the rate of return for Tennessee Gas from 7% to 6⅛%. The company filed the petition last week in the U. S. Fifth Circuit Court of Appeals in New Orleans. FPC issued its order August 9 and directed that Tennessee Gas make a refund. On September 27 the agency denied an application for rehearing.

A 1,000-acre site near Bay City, Tex., has been bought by Celanese Corp. of America for construction of a petrochemicals plant. The company said construction plans for the multimillion dollar installation are in the formative stage, but it will be a "logical extension" of Celanese manufacturing operations in Texas.

enough to make room for the asphaltic crude imports so that the total of imports would not exceed desired levels.

The opposition covered many points, including a claim that there is a sufficient supply of domestic asphaltic crudes if only the asphalt makers would make use of it. And they said asphaltic crude decontrol would add to the current depression of domestic-crude producers.

Furthermore, some pointed out, there was nothing to prevent a company from bringing in asphaltic crudes as a part of its crude-import quota.

There were charges, too, that the approach suggested by the four companies would give a few companies a break over small firms.

In its rebuttal, California Standard argued that those who say there is a sufficient supply of domestic asphaltic crudes have not proved this. By contrast, the company said, it has supplied specific data.

California Standard discounted the argument that domestic exploration and drilling would be discouraged. It said few if any U. S. firms deliberately drill for asphaltic crude.

And it stressed that it had not suggested a specific decontrol plan, but had left that for OCDM to work out on a basis most equitable to all concerned.

No immediate decision by OCDM is likely, although the asphaltic crude problem may be affected by changes in import controls now being considered by the Interior Department in an over-all review of the control program.

Resid Price Check Imminent

• OCDM ready to begin its study of fuel-oil price trends. Oil could lose no matter what the results show.

THE OFFICE of Civil and Defense Mobilization was ready last week to begin mailing out residual fuel oil price-reporting forms.

Actual mailing will start as soon as top OCDM officials approve the final version of the report forms.

There will be two forms, one for shipments from 1957 through 1960, and the other for shipments made after January 1, 1961.

The form for past shipments has been greatly simplified and now covers only cargo deliveries and cargo prices during the 1957-1960 period.

The form to be used next year is more detailed. It covers not only cargo shipments but less-than-cargo deliveries and shipments by barge, tank car, and tank truck.

The information will include monthly volumes and revenues, but the form does not call for a sale-by-sale report.

OCDM said it was announcing the second form 3 months in advance of the time it will be actually used in order to give the companies an opportunity to take steps to have the required information available.

OCDM's move to get specific residual-fuel price information apparently was prompted largely by complaints earlier this year from New England industrialists and congressmen after residual prices were hiked.

OCDM conceded at the time of the protests that it had no system for gathering and evaluating residual price data and therefore was not in a position to judge whether the price hike was justified nor whether it resulted from the import-control plan.

Because the original presidential proclamation setting up import controls specifically authorized Government surveillance of prices, OCDM felt that it was obligated to make a study of the residual-fuel price situation.

An OCDM official said some companies now appear eager to make the reports, feeling that they will show the trend of residual fuel oil prices has been downward, rather than upward.

If such is the case, they feel, the Government will have no cause for considering the imposition of any form of price controls.

An industry observer in Washington said, however, that he fears the pricing issue will grow rather than abate as a result of the Government's current "interest" in residual prices.

His reasoning: If price reports show that resid prices have risen, the New England users will redouble their complaints. And if the reports show a decline, coal interests will charge that "below-cost" resid sales are ruining coal markets.

BRIEFS . . .

Sulfur recovery at a 20-ton daily rate is under way at the Tilden plant of Tran-Jeff Chemical Corp., jointly owned by Transcontinental Gas Pipeline Corp. and Jefferson Lake Sulphur Co. The new plant, near Tilden in McMullen County, Texas, is adjacent to Transco's gas-treating plant for removing acid gas from purchased sour gas.

Mesa Pipe Line Co., a new common carrier headed by Murphy H. Baxter, Midland, Tex., independent, as president, is nearing completion of a new gathering system to handle gas-liquids production from Azalea Strawn and Devonian fields in Midland County, Texas. The system will comprise 55 miles of field gathering lines, a pump station in the field, and a 7¾-mile, 4½-in. main line from the station to Mobil Oil Co.'s pipeline terminal at Midland. The gathering system and discharge line will be a closed, automatic operation. It is slated for completion October 15. The Azalea area it will serve now has 70 Devonian and Strawn wells averaging a total of about 50,000,000 cu. ft. of gas and about 7,000 bbl. of distillate daily.

The oldest of five light-hydrocarbon units in the Texas division of Dow Chemical Co., Freeport, is being mothballed because production capacity of ethylene is above current needs. The plant was built in 1941.

A Udex extraction unit will be constructed at British American Oil's Montreal refinery by Foster Wheeler Ltd. A prime product of the plant will be benzene but the unit has been designed for future production of other aromatics such as toluene and xylenes.

Also for Refiners . . .

IN THE NEWS: Those 1961 automobiles will give refiners no rest (p. 106) . . . There's too little crude, too much product (p. 108) . . . Motor-fuel use to rise 3.5% this year (p. 115) . . . OCDM now set to decide proposed exemption of asphaltic crude from import quotas (p. 116) . . . Government ready to begin check of resid prices (p. 117).

PLUS THIS TECHNICAL REPORT: Gulf builds a new debutanizer tower (p. 246).

Core Tests Tell Where Fractures Go

- AIME gets report on behavior of a frac job and formation notching.

CORES taken at several points around a fractured well in Sacatosa field, Texas, gave Continental Oil Co. engineers this information:

... **The fracture** was horizontal.

... **It extended** at least as far as predicted by the Howard and Fast equation.

... **It was not uniform** in direction or thickness.

... **Fracturing sand** is not changed much during fracture job.

These are the conclusions presented by J. J. Reynolds, J. B. Scott, J. L. Popham and H. F. Coffer to the Society of Petroleum Engineers of AIME at its 35th annual fall meeting in Denver last week.

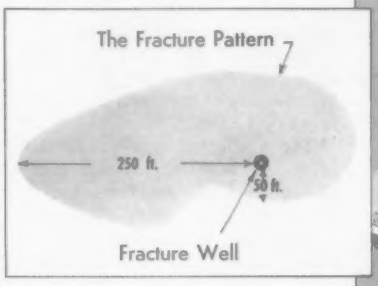
Well No. 37-1, Sacatosa field, Maverick County, Texas (OGJ, Sept. 12, p. 104), was chosen for the field study. It is completed in the San Miguel No. 1 sand. This is a well-consolidated sandstone with a porosity of 23%, permeability from 0.1 to 10 md., and an average thickness of 23 ft. Depth of the San Miguel varies from 1,150 to 1,700 ft.

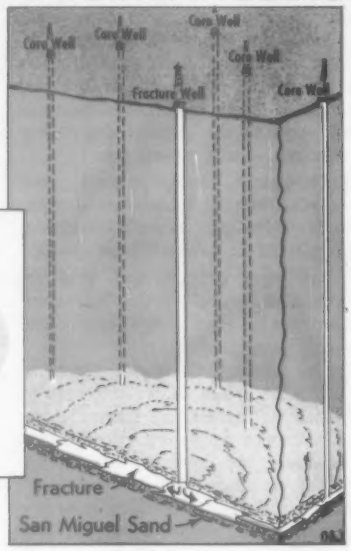
Fracture treatment consisted of 176,000 gal. of diesel oil and lease crude and 270,000 lb. of 20-40 mesh Poteet sand. Formation was broken down earlier with lease crude at a pressure of 2,300 psi. through six perforations in the same horizontal plane.

Fourteen wells were drilled in a circular pattern around the test well. Drilling procedure was conventional down to the top of the San Miguel. At this point a rubber-sleeve core barrel or a conventional core barrel was used to go through the test formation.

How Conoco found fracture results

FRACTURE RESULTS were pinpointed in a Conoco test by coring the formation around Texas well which had been fractured, right. From the cores, it was discovered that the treatment produced the irregular fracture shown below.





Fractures found . . . The cores from the test wells were examined along with the cuttings collected at the surface. Definite evidence of the fracture was found in 8 of the 14 wells. In the remaining six wells, there was no conclusive evidence.

There was no well-defined areal pattern to the distribution of fracture evidence. One well 50 ft. north of the fractured well showed no evidence of fracturing, while in two others 100 ft. away, one of them 15° to the west and one 30° to the east, there was conclusive evidence of fracturing.

On drill-stem test, one of the test wells produced between 600 and 700 lb. of fracture sand. Screen analysis showed that some of the larger grains had apparently been crushed, as the percentage of large grains was smaller than in the original sample, and the percentage of smaller grains had increased.

Formation notching works . . . In another paper on field tests of fracturing, Gulf Oil Corp. engineers reported the results of 23 fracture treatments with single-point entry compared with data from 18 conventional frac jobs.

Higher injection rates and sand concentrations were noted in those wells fractured with the aid of the Gulf notching tool. Limited production data so far shows that more effective well stimulation was obtained with single-point entry.

Authors of the paper are V. N. Swift and W. E. Bauman, Gulf Oil Corp., and J. W. Jennings and J. L. Huitt, Gulf Research & Development Co.

One Well Injects Water, Recovers Oil

A RESERVOIR'S cellar oil can be recovered from a single well by simultaneous water injection and oil production.

This conclusion was reported to the Denver AIME meeting last week by M. H. Gaskell and D. C. Lindley, Humble Oil & Refining Co. Their finding is the result of experiments with a steeply dipping simulated reservoir.

Cellar oil is oil which lies below the lowest producing well in a solution gas-drive reservoir. The lab tests showed that water could be injected into the lower third of the producing zone while oil was produced through perforations in the upper third.

But, there is a critical injection rate and beyond it the injected water will reach the perforations in the upper half of the dual completion. Up to this critical rate, water-free oil is produced from the upper perforations at increasing rates. Past the rate, the water-oil ratio rises and eventually reaches an uneconomic level.

Cellar oil can also be produced intermittently (OGJ, April 20, 1959, p. 62). An amount of water equal to about 84% of the floodable volume is injected into the down-dip well. After the fluids separate in the reservoir, the well is opened to production.

Caskell and Lindley found that mixing of the injected water and in-place oil could be prevented by:

... **Using a low** injection rate so the water "slides in" under the oil.

... **Shutting** the well in after the injection period to allow the fluids to separate.

The lab results show that either method is satisfactory. The time consumed by low injection rates, or waiting for separation following high injection rates, is about the same.

New Importers to Get Quotas

. . . under proposed changes by Interior Department in the residual fuel-oil import plan. Industry reaction waited.

INTERIOR Department last week proposed changes in the residual fuel-oil import plan which, if adopted, would make room for newcomers in District 1.

Interior has asked for industry comments and will consider them before deciding whether to put the new plan into effect.

Under the proposals, newcomers with terminal facilities would become eligible for quotas.

The quotas for historic importers, those currently eligible to import resid, would be reduced on a percentage basis to make room for the newcomers. Thus, the over-all level apparently would not be affected.

If a firm qualifies both as a historic importer and on a terminal input basis, it may choose the procedure which would give it the higher quota. Because of this, some historic residual-fuel importers may get a higher quota than under the current plan.

Procedure for newcomers . . . To become eligible for a quota under the proposed plan, a firm would have to establish that it sells residual fuel oil, that it has deep-water terminal facilities, and that it uses such facilities to store and handle imported or domestic residual fuel oil to which it holds actual title.

The newcomer's base would be the amount of residual-fuel input at his District 1 terminals during the 12 months ending 90 days before a given allocation period.

How newcomer quotas would be determined under the proposed plan is shown in the following example:

Interior would make a certain amount available for newcomer quotas, say a total of 50,000 bbl. daily.

The actual terminal inputs in District 1 during the base period was, say, 250,000 bbl. daily. Thus, the amount to be set aside for newcomer quotas is one-fifth of terminal inputs in the base period.

This means the individual firm would get as a quota 20% of his terminal input during the base period.

Effect on historic importers. The quota for a firm that imported residual fuel during 1957 would be computed differently under the new plan that it has been in the past.

Basically, such an importer would get only 85% of his 1957-based quota. Here is how it would be figured:

Suppose Interior sets the total level of residual imports into District 1 at 400,000 bbl. daily for an allocation period, compared with the level of 340,000 bbl. daily in 1957.

And suppose that Company A imported 5,000 bbl. daily in 1957. His proportion of total imports for that period would be 5,000/340,000.

To determine his quota under the new system, he would multiply that fraction by 85% and then multiply the result by the total quota for that allocation period—400,000 bbl. daily in this example to get his quota.

The answer would be a quota of 5,000 bbl. daily.

Other provisions proposed by Interior:

Bonded residual fuel oil held at deep-water terminals could not be used in computing individual allocations.

Residual fuel oil held at deep-water terminals could be used only by the title holder in computing individual allocations, and a transfer between such facilities to other eligible importers may result in an adjustment of computing allocations.

Text of Interior's proposals may be obtained from the Federal Register or by writing the Oil Imports Administration, Interior Department, Washington 25, D. C.

Offshore Lease Interest High

CALIFORNIA officials will reveal October 27 how much land off Santa Barbara County they will put on the leasing block.

Any acreage offered is expected to be snapped up by oil companies hungry for a piece of what looks like a promising oil area. The last sale in mid-1958 brought in $55 million for five parcels of 3,840 acres each. The land to be offered at the next sale is on both sides and in between these five blocks.

The State Lands Commission is considering offering 50,000 acres at the sale. This would make the sale the biggest offshore offering in California's history.

But a decision on how much land will be included in the sale has not been made. Some think the commission will split the pie and spread the 50,000 acres over two or more sales.

Frank Hortig, director of the commission, says it will be at least mid-January before the sale can be held. The date will be announced along with the total acreage at the meeting later this month in Los Angeles.

The commission has decided to use bonus bidding in awarding leases. The bonuses will be in addition to the sliding-scale royalty used by California. The royalty starts at 16⅔% for a well making up to 100 bbl. daily and runs up to 50% for a well making 500 or more barrels daily.

Richfield Oil Corp. led a drive to get leases awarded strictly on a royalty basis, but the commission decided the state could earn more revenue faster by using bonus bidding.

Activity in area . . . Four of the five tracts leased in 1958 show some promise of coming up with commercial production.

Phillips Petroleum Co., operator for a 33-party combine which holds leases on two blocks, recently completed its first well on Parcel A, the most easterly of the five blocks. The discovery, like other holes drilled in the area, was a no-dope hole. Location for a confirmation test has been staked 95 ft. west of the discovery.

Phillips whipstocked the well from an onshore location. Total depth was 8,871 ft. and the pay sand was probably around 4,500 to 5,000 ft. vertical depth.

Texaco Inc. has reached a total depth of 4,600 ft. on its first wildcat in Parcel D. The well is being drilled from a $3-million, 28-well platform (OGJ, Oct. 3, p. 144).

Just last week Texaco announced it will drill a second well from the platform. The company is operator for itself, Monterey Oil Co., and Newmont Oil Co.

The Phillips well is the only official discovery announced in the five blocks, but Texaco apparently has discovery in Block D.

Standard Oil Co. of California and Humble Oil & Refining Co., have completed a well whipstocked under Parcel C. This well had shows of gas and condensate, but Socal has never reported it as a discovery.

The Phillips combine apparently has had some encouragement in core drilling on Parcel E since the company has ordered an offshore platform which will be installed this year.

Only Parcel B, held by Socal and Humble, has been a complete washout. Several dry holes have been drilled on this block.

Venezuela Fights Crude Discounts

• Producers who cut prices may be shut down. This move and the decision in the Middle East to base oil taxes on prices before the recent cuts, are new efforts by exporting countries to stabilize the crude market.

THE PRODUCING nations of the world are making progress in their efforts to stabilize prices and market conditions, Dr. Juan Pablo Perez Alfonzo, Venezuela's minister of mines and hydrocarbons, declared during a recent press conference in Washington, D. C.

The oil minister was on his way home from the Baghdad conference where delegates from Venezuela, Iraq, Iran, Saudi Arabia, and Kuwait signed a set of resolutions reflecting their countries' oil goals.

As a result, the Middle East participants are notifying oil companies that their oil taxes will be based on posted prices prevailing before the recent Middle East crude price cut, Dr. Perez Alfonzo said.

Venezuela, he said, is taking even more decisive action. It has notified oil firms that they must abide by posted prices or face the danger of having their production stopped entirely.

He said discounts would be permitted only in long-standing contracts with traditional markets. And an effort is being made to trim these discounts to no more than 5%, he revealed.

The oil minister estimated that currenly about 80% of Venezuelan crude is being sold at discounts of not more than 10%. The remainder, he said "may" be selling only at posted prices.

At any rate, he made clear, Venezuela will make a determined effort to eliminate discounts wherever possible and to limit those it does permit to 5%.

Companies which do not cooperate will have their production stopped, he warned. He said this had already happened in a case or two. He declined, however, to reveal names.

Concerning the move at Baghdad to develop concerted action to control production, he said he does not foresee any major obstacles to such a plan "because there are just five countries, so an agreement on proration should not be difficult."

He conceded, however, that the effort to minimize discounts and to stabilize prices might cause some shifts in market outlets. For instance, he predicted that Saudi Arabian sales to Venezuela's neighbor, Trinidad, would end because—with posted prices enforced—Trinidad would get crude delivered more cheaply from Venezuela.

At the same time, he said, Venezuela may lose some of its markets in Europe to Middle East oil.

He expressed little fear of Russian crude for, he said, the Russians want to get a good price, too.

And he termed crude from Sahara as "too expensive" to create any real problems for producers of crude in other nations.

Over the long run, he expects that the Americas — both North and South—will have to depend on some Middle East crude to supplement their own supplies.

Iraq Bargains for IPC Stock

IRAQ is believed pressing for a stock interest in Iraq Petroleum Co. in the second round of government-company talks now under way in Baghdad.

The Iraq Embassy in London stated in a monthly bulletin that the government wants to acquire a holding in the capital stock of IPC. It said this is one of the principal differences in current negotiations.

Among the other questions mentioned by the embassy are the training of more Iraqi technicians, appointment of Iraqi directors to IPC, and utilization by the government of IPC gas production.

Argentina Headed for Record Drilling Year

• Private companies are taking the lead over the government petroleum agency. And the drilling program has raised production to new highs.

PRIVATE companies in Argentina are now completing wells at a faster rate than YPF.

Figures now available show that operators with multi-million-dollar drilling contracts with YPF, the state agency, completed 273 wells the first half of the year. Of these, 249 were completed as oil producers, and 24 were classed as dry holes.

YPF in the same period completed 251 wells, of which 197 were producers, and 54 dry holes.

This many completions by the mid-year mark means that last year's record level of drilling will probably be doubled. The YPF and private company January-June total of 524 completions compares with 573 for all of 1959. Last year's footage total of 3.4-million ft. may also be doubled.

The results of the high completion rate are showing up in surging crude production. Private companies in July accounted for 49,900 bbl. daily, more than double the January level of 23,-500 bbl. daily. This pushed Argentine output for the month to an all-time record peak of 167,800 bbl. daily.

Pan American (Indiana Standard) was ahead of the field with a total of 76 field completions and 6 wildcat completions on a 1,500-sq. mile block in Comodoro Rivadavia. A new 83-mile 12 and 14-in. pipeline to the coast enabled Pan Am to step up output from 4,500 to 23,100 bbl. daily between March and July. Rated capacity of the system is 50,000 bbl. daily.

L. R. Development Co., headed by the New York banking firm of Carl M. Loeb Rhoades, stepped up output

from 8,400 bbl. daily to 17,800 bbl. daily from January to July as the result of 21 completions in its Mendoza producing area. It completed 3 wildcats as producers in Comodoro Rivadavia.

The remaining 9,000 bbl. daily came from old producing properties held by private companies. Diadema Argentina (Shell) produced 6,200 bbl. daily. Two local companies, Astra Cia. Argentina and Petroquimica each produced 1,300 bbl. daily. Esso Production de Petroleo output was 200 bbl. daily.

An affiliate, Esso Argentina, drilled four dry holes in its wildcatting program on a 1,180,000-acre tract in Neuquen. Another Royal Dutch company, Shell Production Co., limited itself to seismic work earlier in the year on a 11,500-sq. mile tract covering parts of Buenos Aires and Rio Negro Provinces.

The increased production is making deep cuts in Argentina's oil imports bill. President Arturo Frondizi said the country saved $76 million last year in foreign exchange as the result of increased output, which averaged 122,100 bbl. daily.

YPF in February said it no longer needed to import foreign crude, and renegotiated a purchase contract with British Petroleum to bring in 34,000 bbl. of products rather than crude. Private refiners, however, continue to purchase foreign crude needed to supply the balance of demand.

How operators fared in Argentina

(First Half 1960)

Private operators—	Field wells— Oil	Dry	Wildcats— Oil	Dry	Total— Oil	Dry
Pan American	69	7	5	1	74	8
Loeb Rhoades	21		3	3	24	3
Esso Argentina				4		4
ENI	60	3			60	3
Transworld (Kerr-McGee)	28				28	
Southeastern Drilling	46				46	
Union Oil				4		4
Tennessee Argentina	9	1	3	1	12	2
ASTRA	5				5	
Total	238	11	11	13	249	24
YPF	181	31	16	23	197	54
Total	**419**	**42**	**27**	**36**	**446**	**78**

Offshore Development Is Pushed in Japan

• A drilling program is slated for Kubiki gas field. At Tsuchizaki a submarine line is being laid to move oil to domestic markets.

JAPAN'S FIRST multi-well drilling platform is being built in the Sea of Japan as part of a program to tap the country's best gas field.

The 8-well platform of McDermott design is being erected 950 ft. offshore over Kubiki gas field. The jacket-type piling platform will have deck space of 5,400 sq. ft and be connected to shore by a steel bridge. The $830,000 platform is scheduled for completion by the end of November. Directional wells drilled from the island will be in the 6,500 ft. range.

Further north on Honshu Island, the Japanese are laying a submarine flow line from a new oil discovery near Tsuchizaki.

Develop gas supplies . . . The Kubiki drilling program ties in with plans by the operator, Teikoku Oil, to sell gas to Tokyo Gas Co. for use as fuel in the Tokyo area.

Plans for a pipeline to Tokyo still are in a formative stage, but Teikoku Oil and Tokyo Gas are negotiating a proposed 200-mile 12 in. system that would deliver a minimum of 17,500 M.c.f. daily.

If the plan materializes, the natural gas supply would supplant at least a quarter of Tokyo Gas, annual production of town gas. The pipeline would cost about $14 million.

Teikoku Oil decided to try to sell its gas as a household fuel, rather than as a raw material for petrochemicals after a visit to Europe by K. Kishimoto, company president. After discussions with Montecatini, CFP, and other groups, he returned home convinced that economics in this case favored marketing the gas as a fuel.

Kishimoto believes Kubiki gas can be delivered at 59 cents per M.c.f. which would make it competitive with Tokyo Gas' coal gas, which runs as high as $1.00 per M.c.f. Both prices are expressed in terms of 400 B.t.u.'s per cubic feet.

Tokyo Gas also is studying the comparative economics of relying on crude gasification at an estimated 71 cents per M.c.f. or LPG imports, estimated at 91 cents per M.c.f.

Japanese gas reserves were greatly increased at the turn of the year when a Kubiki field well, Katamachi 16 came in with a potential of 35,000 M.c.f. daily. The well was completed in two zones, one a 30-ft. pay topped at 3,140 ft. and the other a 13-ft. pay topped at 3,340 ft. The well blew out twice, and the second time was brought under control through the efforts of Myron Kinley (OGJ, Feb. 22, p. 85).

Offshore oil . . . Japan Petroleum Exploration Co. (JAPEX) went ahead with its project for a submarine flow line from a new field discovery off Northwest Honshu after Tsuchizaki 3 came in with a flow of 1,800 bbl. daily through an unidentified choke. The well is the third producer completed from a platform 1.4 miles off Tsuchizaki, Akita Prefecture.

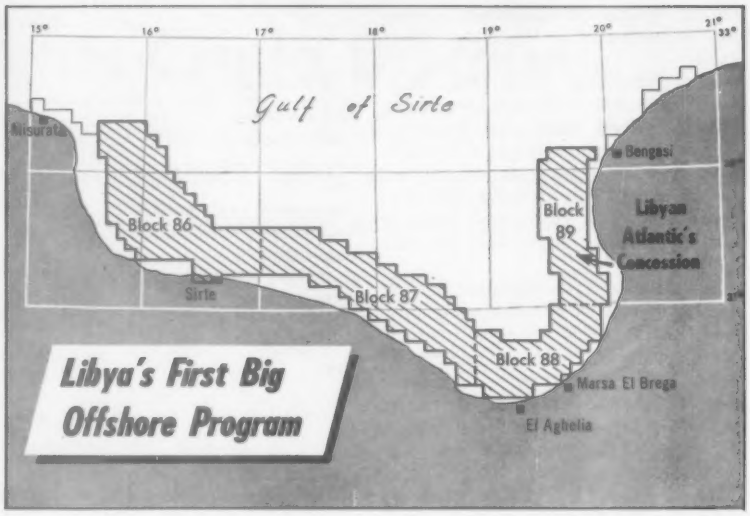
The No. 3 well is a directional well completed at 2,000 ft. and 590 ft. south of the discovery, which last year tested 1,900 bbl. daily through a 1½-in. choke. Production is from 1,780-1,920 ft. in the upper Katsurane sand. The No. 2 well, 430 ft. east of the discovery, is in the same class.

A Le Tourneau-type platform has been moved 1,640 ft. south of the discovery and is now drilling the fourth test.

Tsuchizaki production will help boost Japan's domestic output this year to an average 10,500 bbl. daily. JAPEX has registered other successes in Mitsuke oil field, in West Central Honshu, where development drilling has extended reef production to the north.

Libyan Atlantic Plans Offshore Oil Hunt

- **Seismic program is set for the huge concession area in Mediterranean.**



THE FIRST major oil search in the waters off Libya will begin in November.

Libyan Atlantic, an affiliate of Atlantic Refining Co., will be making its initial seismic study of the 6,700,000-acre concession in the Gulf of Sirte, which was awarded to the company early this year.

Geophysical Services, Inc., will do the work for Atlantic with two boats now being fitted in Malta. The crews will start in the Bengasi area and work their way east.

It is estimated that the program will be completed some 6 or 7 months after its start. Libyan Atlantic hopes to spud its first test in the Mediterranean waters in 1961 or '62.

Exploration plans . . . Information gathered in the survey will be taped and then forwarded to GSI's processing center in London.

Interpretation of the data will be by GSI and Atlantic geophysicists.

While the geophysical exploration is in progress, Atlantic will run a marine seep survey on the concession. A marine "sniffer" designed and developed by Atlantic's research and development laboratories will be used.

The device has been automated and is being fitted on the seismic boats.

The concession . . . Shoreline distance of Atlantic's concession, which comprises four separate blocks, is approximately 400 miles. The seaward liimts of the area range from 25 to 50 miles offshore. One jag in the concession boundary includes the land area around the town of Sirte.

Water depths in the block are from zero to about 1,800 ft. However, only one relatively small area contains the maximum depth. It is located north of Marsa El Brega. Throughout the rest of the concession the maximum depth is about 900 ft.

FOREIGN BRIEFS . . .

The Spanish Government has turned down proposals by both Jersey Standard and Royal Dutch-Shell to build petrochemical facilities. The reasons for the move are a fear of overproduction for local needs and a lack of foreign markets.

. Diesel oil from coal is the goal of an experimental program now in progress in India. Methods are being studied to produce diesel from low-temperature tar-oil fractions which are made from high-moisture coal in the Raniganj fields of West Bengal. The study was prompted by the growing demand for diesel which has increased an average of 30% a year for 15 years.

A lube-oil plant in Syria will be built by the Russians under a new agreement on economic and technical cooperation with United Arab Republic. The plant will have a capacity of 25,000 tons a year. Russia will also expand its exploration aid.

A new Russian tanker, the "Warsaw," has left the Black Sea with 27,000 tons of crude for Cuba. The ship, Russia's second in a new 40,000-ton 18-knot class, was rushed to completion a month ahead of schedule in Leningrad.

Contract for a 20,000-bbl. per day Unifiner-Platformer to be added to Iranian Oil's refinery at Abadan, Iran, has been awarded by Iraanse Aardolie Raffinage Mij. (Iranian Oil Refining Co.) to Fluor-Schuytvlot N.V., Haarlem, Holland. The $5 million contract is being carried out by Fluor Engineering & Construction Co., Ltd.

Two stepouts to a Russian discovery near Mulymya in western Siberia have been brought in as producing wells. One has an open flow of 2,544 bbl. daily, compared with 220 bbl. daily in the discovery (OGJ, June 13, p. 82). The other tests 436 bbl. daily of crude and 176,000 cu. ft. of saturated gas daily.

A $28 million petrochemical development will be built adjoining British Petroleum's 70,000 bbl. refinery at Llandarcy, Wales, by British Hydrocarbon Chemicals Ltd., which is owned jointly by BP and Distillers Co. Ltd. A site covering several hundred acres has been proposed for the complex.

Polypropylene will be manufactured in the Netherlands by a joint company to be formed by Royal Dutch-Shell and Montecatini. The company will build and operate a polypropylene plant in Rotterdam in conjunction with the Shell Netherlands refinery. Montecatini patents will be used and the marketing will be handled by Royal Dutch-Shell companies.

The French affiliate of British Petroleum is negotiating with CFP and Antar for a proposed refinery at Strasbourg, France. The design, size, and cost are not yet final. A Shell affiliate plans a second refinery in the area.

Romania and Indonesia have signed a technical cooperation contract which provides for the sending of Romanian oil specialists to Indonesia.

ANNUAL PIPELINE NUMBER

Here is the NEW

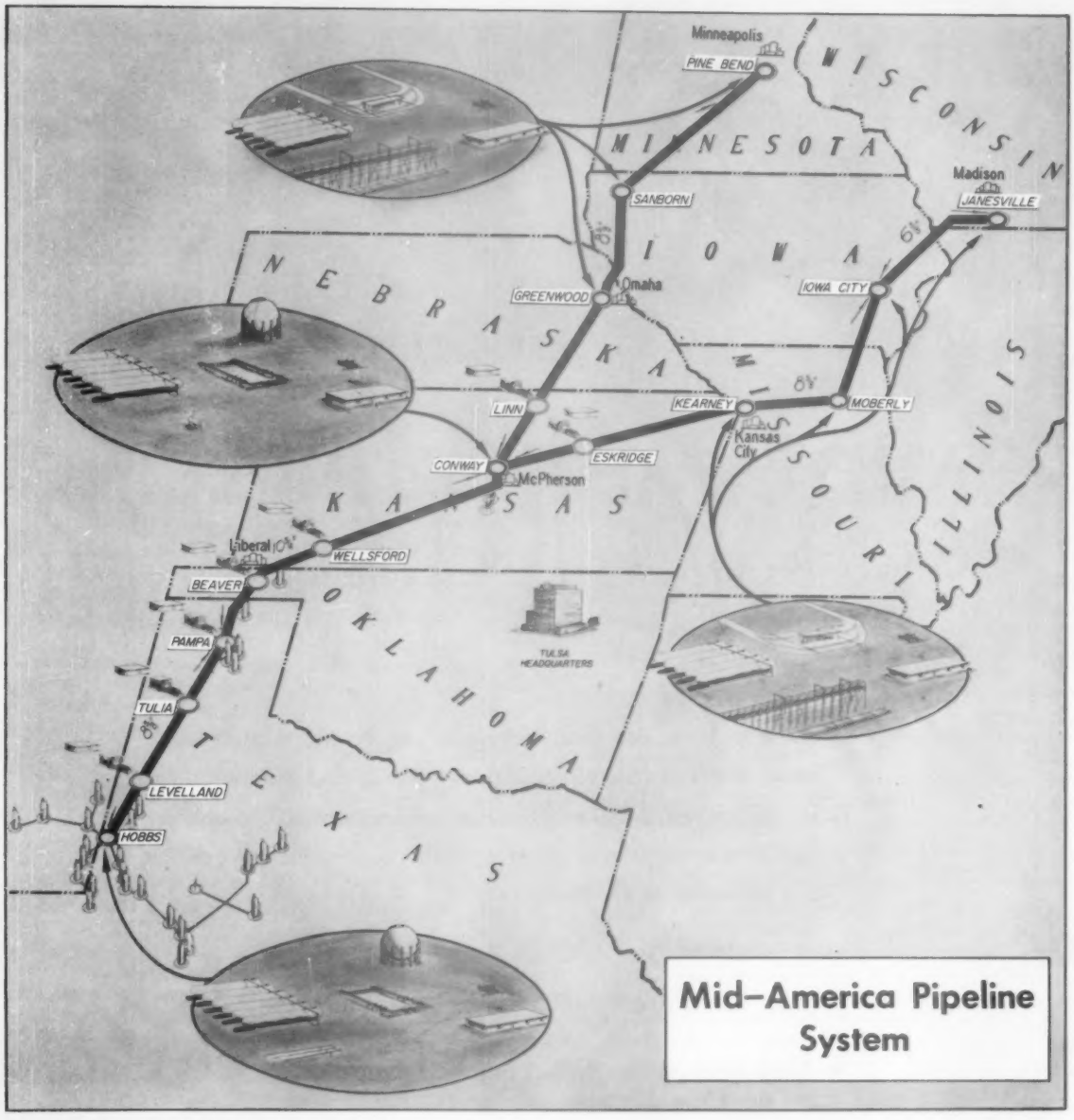
MID-AMERICA PIPELINE

World's first major LPG system

This 8 to 10-in. line extends from Eunice, N. M., to McPherson, Kans., with branches to Minneapolis, Minn., and Madison, Wis. The $67 million, 2,200-mile line has a capacity of 50,000 bbl. per day. Here are articles on general aspects, construction, and design and operation of the line.

Plus

- How Good Are Pipeline Control Systems? ..... p 164
- New Remote-Controlled Engine-Driven Station on the Little Big Inch. ..... p. 190
- Remote Control Is Feature of Gas-Turbine Compressor Station. ..... p. 200
- Here's What's Needed for Pipeline Pipe. ..... p 211
- Updating the Bayou Pipe Line System. ..... p. 226
- Capacitance-Type Interface Detectors Aid in Operating Products Line. ..... p. 235



MID-AMERICA'S $67,000,000 pipeline for shipping directly from gasoline plants in the Permian basin producing area to rapidly growing markets in northern states.

First major all-LPG pipeline will be operating by December

The president of Mid-America tells how it breaks pipeline precedents, how it will function, who owns it, and what it intends to accomplish.

BY ROBERT E. THOMAS
President, Mid-America Pipeline Co.

These men operate...

ROBERT E. THOMAS, president, Mid-America Pipeline Co., has a BS in economics, Wharton School of Finance and Economics, University of Pennsylvania, 1936. He was concerned with railroad investments while with Keystone Custodian Funds, Boston, 1936-53, and then with Madison Fund, Inc., New York, until 1959. Since 1956 he has been chairman of executive committee, M-K-T Railroad.

DAVID A. ROACH, vice president, Mid-America Pipeline Co., spent 14½ years with Phillips Pipe Line Co. before joining Mid-America. He was chief engineer, later vice president of Phillips Pipe Line. He spent 5 years with the U. S. Army Corps of Engineers. Roach was graduated from the University of Nebraska as a civil engineer in 1941.

and these men built Mid-America

JOHN H. WILLIAMS, president, Williams Brothers Co., earned a BS in Civil Engineering, Yale University (Sheffield Scientific School) in 1940. He was with Williams Brothers in Venezuela before World War II and the Navy Civil Engineer Corps during the war. He was project manager, Poza Rica-Mexico City gas line, and was made assistant to the president, South American operations, 1949.

VINCENT E. BUTLER, vice president, Williams Brothers Co., was project manager on Mid-America Pipeline. He has a BS, Civil Engineering, Tri-State College, 1941. He was a civilian engineer, Panama Canal, and was with the Navy during the war. He was with Texas Petroleum Co., Venezuela, 1946-52, joined Williams Brothers in 1952, was elected vice president, 1956.

THE MID-AMERICA pipeline is the first major common-carrier system devoted exclusively to LPG. Because of its large service area, a variety of effects may be expected. Supply and marketing areas of the line will be served for the first time with a large-volume, low-cost, efficient facility for transporting these products. Consequently the pipeline will bring a different set of economic conditions for everyone doing LPG business in its territory.

This system aims primarily at handling large volumes of propane. Gradually shipments of feed stocks for refineries—and eventually for petrochemical plants—are expected to become important. Movement of these materials by the pipeline will supplant railroad transportation.

The Mid-America line is more than a facility. It will be a force for increasing the use of LPG, for changing transportation and distribution patterns, and for attracting petrochemical plants to the area served.

Facilities. Mid-America's $67,000,000, 2,200-mile system of 4-6-8-10-in. pipe extends from Eunice, N. M., in the Permian basin first as a main line to Conway, Kans., 8 miles west of McPherson, where it branches to Pine Bend (Minneapolis) area and to Janesville, Wis.

Design capacity to Conway when fully powered will be 85,000 bbl. daily. Initial daily capacity to Conway will be 50,000 bbl. Each of the two branch lines will have 30,000-bbl.-daily capacity, a total of 60,000 bbl. per day. But fully powered, the two branch lines are designed to handle 86,000 bbl. per day.

The line will be in full operation by December 1, and, ignoring the early transition period, throughput is expected to hit 38,000 to 40,000 bbl. per day in 1961.

Planning

Why and how was the Mid-America system put together? The logic of the situation showed Katy Railroad management that it would be only a matter of time before someone would build such a system. Demand for propane in the upper Middle West had reached sufficient volume to warrant such a pipeline. Demand is continuing to expand, making the pipeline investment steadily more attractive.

Demand. Daily sales of propane averaged 44,300 bbl. in 1955, 53,700 bbl. in 1958, and 68,000 bbl. in 1959 in Mid-America's eight-state area of Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin. In 1960, sales are expected to exceed 70,000 bbl. daily. Use is about 80% residential and commercial, 8% industrial, 8% internal combustion, and 4% miscellaneous.

During 1958, daily imports into this area averaged 45,500 bbl. Of this, 99% came from New Mexico, Texas, and Oklahoma. Imports today are correspondingly higher than in 1958.

In the supply area, 116 existing gasoline plants have economic access to the pipeline. These plants produced approximately 270,000 bbl. per day of natural-gas liquids in 1959, of which 40% was propane.

Evolution. Katy began working on a pipeline program in 1957, when Williams Brothers was retained to carry out feasibility studies. It explored the possibilities of laying a pipeline along railroad right-of-way in partnership with another railroad. When the scheme was judged unfeasible, this plan was dropped and the partnership discontinued. Katy continued alone.

The plan now materializing in the Mid-America system was then devised. Assurance was given by the persistent interest of firms which would benefit by using the pipeline. The next step was to break precedent in undertaking the financing of a major petroleum line without shipper ownership. During 1959, letters of intent to use the line were secured from enough shippers to justify construction. Financing was arranged early in 1960 and Williams Brothers was given a contract to engineer, design, and construct the system. The first pipe was laid on April 25, 1960.

Status. Mid-America is not a railroad subsidiary but stands on its own. Katy made no pledges in connection with the financing of Mid-America and has only 19% of Mid-America

AERIAL VIEW of Conway station and McPherson, Kans., terminal at junction of main line and laterals branching to Minneapolis and Milwaukee. Manifolds handle products from main line and shipments going in and out of underground and aboveground storage as well as those destined for the lateral lines. Dehydrators and tanks are prominent in the photo.

common stock. The balance is publicly owned by about 4,000 stockholders.

Mid-America is simply a transportation company without interests in production, brokerage, or marketing of propane.

Organization

The two top officers and several directors of Mid-America are closely connected with Katy Railroad affairs. The remainder of the Mid-America officers, supervisory personnel, and technical staff are being recruited principally from the petroleum and pipeline industries.

David A. Roach, Mid-America's vice president, was formerly a vice president of Phillips Pipeline Co. G. V. Rohleder, Mid-America's general superintendent, was formerly a vice president of Okan Pipeline Co. All four of Mid-America's district superintendents are men with considerable pipeline experience.

Possible Effect on Demand

Construction of pipelines giving efficient, dependable supply of a product usually stimulates demand. This is likely to happen in the case of Mid-America. Distributors of propane in the upper Middle West have often turned down some types of business, such as house heating, because they lacked a dependable supply during critical periods.

Propane marketers are now looking at potential new business because the pipeline will provide a dependable quantity of propane "on the customer's doorstep" so to speak.

They also realize that the pipeline will be able to step up deliveries quickly with the coming of a cold snap. This will be of great benefit to the entire industry, including producers. With the pipeline packed with propane, it is only necessary to step up injection in West Texas in order to step up withdrawals a few hours later in the upper Middle West. Mid-America will provide a dependable supply to an extent no other form of known transportation can possibly equal.

Smaller bulk plants, off railroads and served by keystop truck deliveries, are being planned and will further increase distribution efficiency.

Advantages of System

Mid-America's most important advantage is the continuous supply of products. Dependability of delivery is probably worth even more than attractive tariffs. But Mid-America is giving both. Its rates are 35 to 50% less than those of railroads.

Some proposed pipeline rates and present railroad rates per barrel are:

Eunice, N. M. to	McPherson	St. Paul
Proposed pipeline rate*	$ .50	$ .95
Present rail rate	1.10	1.73

Pampa, Tex. to	McPherson	St. Paul
Proposed pipeline rate*	.35	.80
Present rail rate	1.04	1.68

*In addition, the company will charge 8 cents per barrel on deliveries to consignees through its terminals other than McPherson.

Mid-America shippers will have a substantial advantage over those who ship by rail from the Permian basin and the Panhandle to the upper Middle West.

Operation. Propane will be handled in a common stream. Specifications for propane have been established by Mid-America and shipments will be accepted only after rigid tests to insure compliance. Maintenance of standards will be the responsibility of the pipeline.

Mid-America will own the propane line fill. When propane is accepted by the line the shipper's account is credited at completion of delivery. This permits him to withdraw an equal amount at a delivery point in the upper Middle West. Thus, travel time and the need for anticipating weather is eliminated. This is an important advantage which we believe shippers will appreciate more and more as they gain experience.

The initial basic plan is to have the two branch lines north of Conway ship propane almost entirely. South of Conway butane and natural gasoline will be handled for the account of shippers. Ultimately butane as well as propane will move north out of Conway.

Storage. The storage of Mid-America is solely to serve pipeline operations, to provide for peaks, and to tide over propane at a terminal while a batch of butane goes by. None of the company storage is to be rented to shippers. Their storage must be arranged by them elsewhere.

Shipments. Shipment size has been determined to permit economical operation. Conditions are suited to the convenience of firms engaged in producing and marketing.

Shipments of 10,000 bbl. or more will be accepted from one or more plants able to deliver such amounts in 48 hours. As a first requirement,

the shipper must control a minimum of 10,000 bbl. storage at a single destination on the line.

Some of the shippers have underground storage in the McPherson area. Tuloma, Sinclair, and Cities Service have underground storage at Hutchinson, Kans. Other shippers are leasing storage.

Loading directly out of the company's terminals is permissible only in tank cars or in 5,000-gal. or larger tank trucks. Except for these minimum requirements no shipper storage is required at terminals along the system.

Market stimulation. Mid-America will advertise to promote greater use of LPG in its territory. Such advertising of propane and its uses should be good for all shippers. It will emphasize the cleanliness of propane and the reliability of supply assured by pipeline service. Customers will be urged to patronize dealers using the Mid-America system.

Mid-America will try to induce petrochemical plants to locate in its territory. It seems inevitable that such plants will come into Wisconsin, eastern Iowa, northwestern Illinois, northern Missouri, or the Twin Cities areas. Plants closer to population areas benefit because transportation of raw material is cheaper than that of finished products.

Savings. The line will enable shipper-producers to eliminate certain tank-car loading racks. For example, a producer, shipping some of his products by pipeline, who has six plants may find he can operate with two racks instead of six. Connected plants may save cost of increasing storage and loading facilities when future plant expansions occur.

Producers should also benefit by the elimination of operating losses on tank cars. Interstate Commerce Commission figures show that the average tank car earns mileage on 17,000 miles a year. At the rate of 5½ cents per mile, this produces total average earnings of $935 yearly. Yearly rental cost is substantially higher.

Future Outlook

Mid-America will not be affected by other pipelines. As a low-cost carrier of propane, butane, and other natural-gasoline plant products, Mid-America can compete with lines not carrying such a large volume of these products.

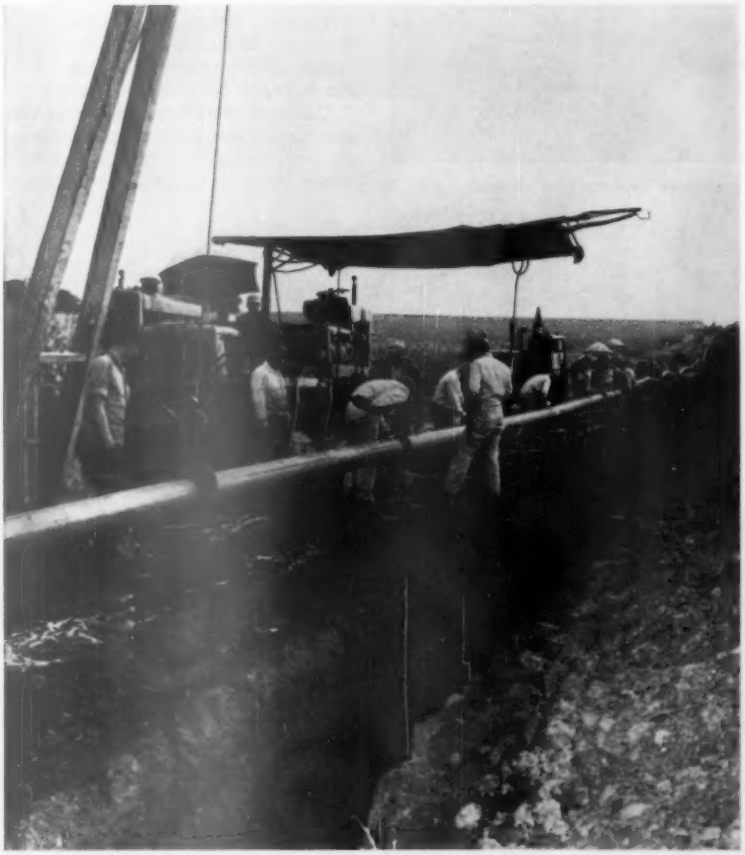
If Mid-America is aggressive and maintains a reputation for fair dealing, it should have a bright future through its philosophy of high-volume, low-tariff operations.

Mid-America is ready to serve the petroleum industry by expansion of the system now under construction, by building lines in other areas, or by the acquisition or operation of existing pipeline systems.

In short Mid-America stands ready to go wherever there is an opportunity to make money out of pipelining for its stockholders.

Laying schedule required exact timing

BY V. E. BUTLER
Vice President
and
E. M. HUBACH
General Superintendent,
Williams Brothers



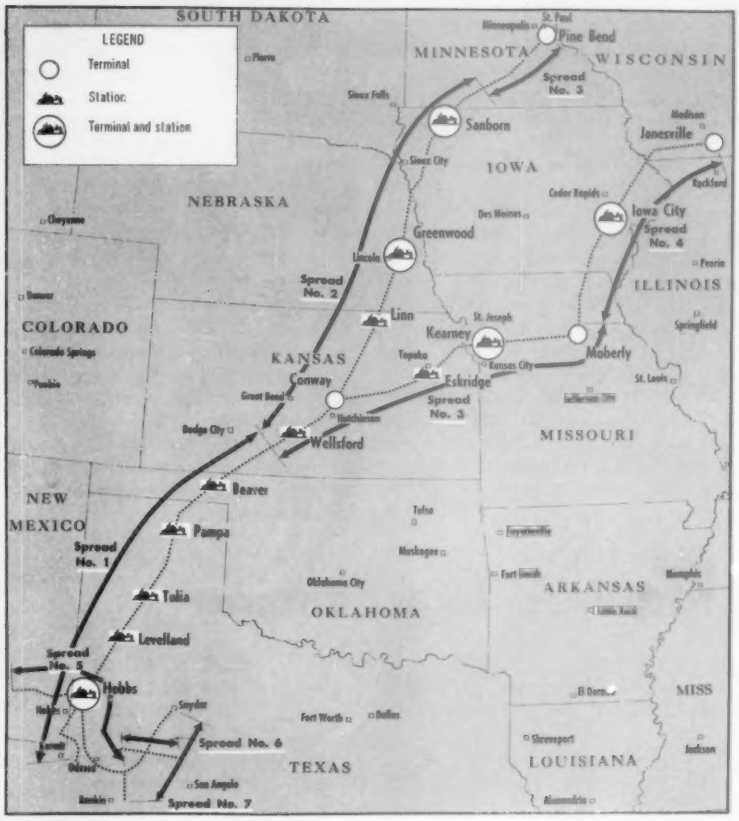
PIPE GANG with two stringer bead and three hot-pass welders at Williams Brothers spread laying lateral line in Spencer, Iowa, area.

DESIGN and construction of the Mid-America Pipeline System, 2,175 miles of pipeline, 6 delivery terminals, 2 operating terminals, 13 pumping stations, cavern, storage, and communications, will take 175 working days.

The task before Williams Brothers was the near-simultaneous performance of the engineering, right-of-way acquisition, material procurement, and construction. The schedule would not permit otherwise.

Advance arrangements to commence surveys, right-of-way acquisition, design, and material procurement permitted a flying start on April 6. The completion date for the entire system was set at December 1.

Teamwork among the assigned personnel was the key to this operation. Notice to proceed was given to Williams Brothers on April 6. The service organization commenced full-scale survey, right-of-way acquisition, engineering, and material procurement on that date. Two main-line spreads began pipe laying on April 25. There have been no serious delays in the performance of the work and the useful completion of the project will be on schedule.



CONSTRUCTION ASSIGNMENT for seven main-line construction spreads. Fig. 1.

The general organization of the project is shown in Fig. 2. It represents the services of approximately 1,100 people.

Equipment and material suppliers were very cooperative. They exercised special effort to meet accelerated completion schedules. They were, in effect, a part of the organization.

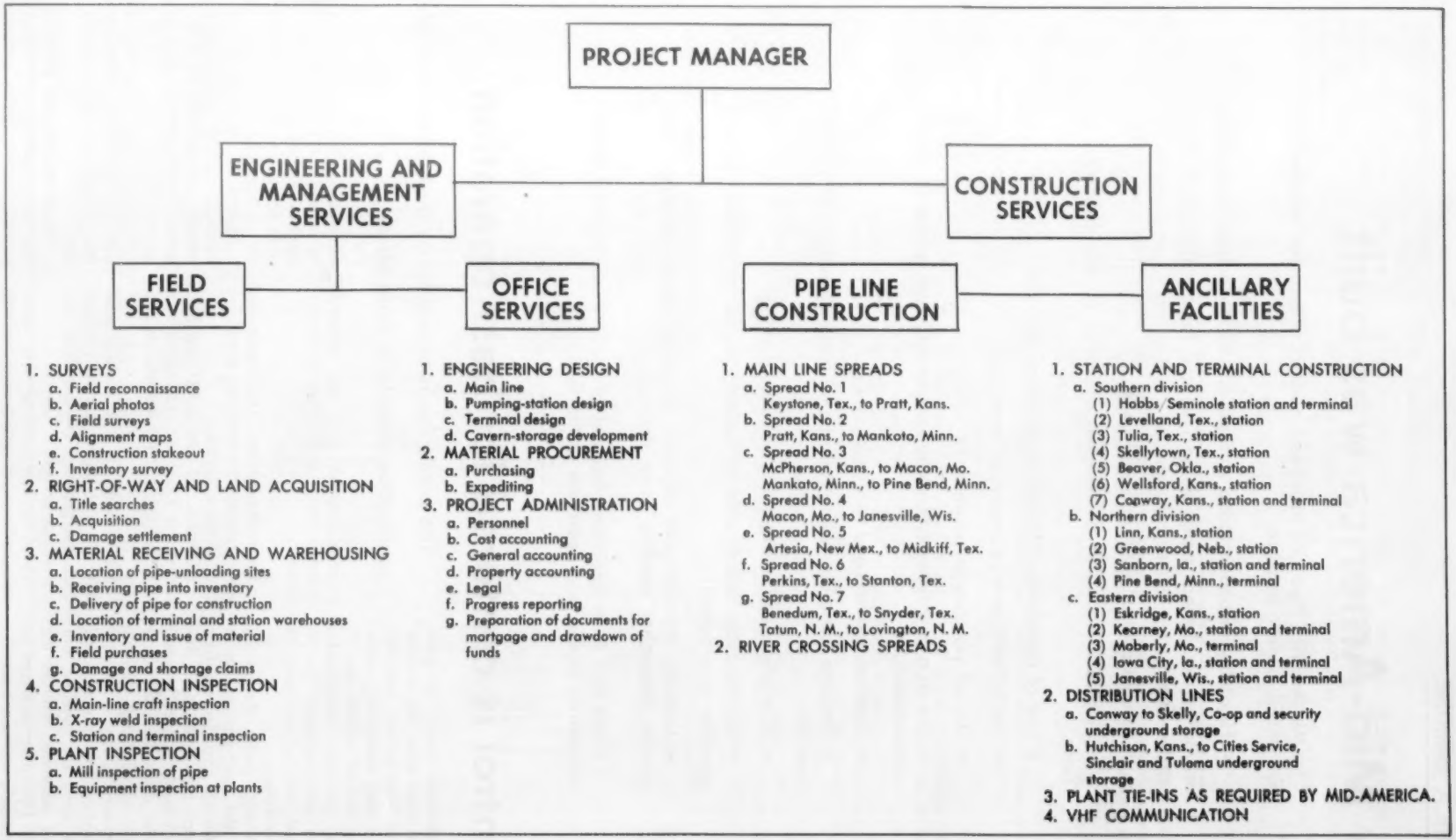
The scope and time schedule of the work necessitated the use of subcontractors. They were used on certain sections of pipeline construction, for surveys and right-of-way acquisition, for construction of ancillary facilities, and on certain river crossings.

Seven main-line construction spreads were used in the pipe-laying operation. Four of the contractor's major spreads will lay approximately 1,700 miles of 8 and 10-in. pipe. Three subcontract spreads were used in the New Mexico and West Texas area of the pipeline to lay approximately 475 miles of 4, 6, and 8-in. pipe. The latter also made the tie-ins to plants furnishing product to the pipeline. Fig. 1 shows the construction assignment of each spread.

Four river-crossing spreads were used for the major rivers. These spreads combined both the contractor and subcontractors for crossing the Canadian, Beaver, Arkansas, Platt, Missouri, Kansas, and Mississippi rivers. Other rivers were crossed by the main line or subcontracted spreads.

Qualified station and terminal subcontractors constructed the pumping stations, terminals, and lateral lines under Williams Brothers' supervision.

BACK HOE digging ditch preparatory for making a highway crossing in Iowa.


PROJECT MANAGER
ENGINEERING AND MANAGEMENT SERVICES
CONSTRUCTION SERVICES
FIELD SERVICES
OFFICE SERVICES
PIPE LINE CONSTRUCTION
ANCILLARY FACILITIES
1. SURVEYS
a. Field reconnaissance
b. Aerial photos
c. Field surveys
d. Alignment maps
e. Construction stakeout
f. Inventory survey
2. RIGHT-OF-WAY AND LAND ACQUISITION
a. Title searches
b. Acquisition
c. Damage settlement
3. MATERIAL RECEIVING AND WAREHOUSING
a. Location of pipe-unloading sites
b. Receiving pipe into inventory
c. Delivery of pipe for construction
d. Location of terminal and station warehouses
e. Inventory and issue of material
f. Field purchases
g. Damage and shortage claims
4. CONSTRUCTION INSPECTION
a. Main-line craft inspection
b. X-ray weld inspection
c. Station and terminal inspection
5. PLANT INSPECTION
a. Mill inspection of pipe
b. Equipment inspection at plants
1. ENGINEERING DESIGN
a. Main line
b. Pumping-station design
c. Terminal design
d. Cavern-storage development
2. MATERIAL PROCUREMENT
a. Purchasing
b. Expediting
3. PROJECT ADMINISTRATION
a. Personnel
b. Cost accounting
c. General accounting
d. Property accounting
e. Legal
f. Progress reporting
g. Preparation of documents for mortgage and drawdown of funds
1. MAIN LINE SPREADS
a. Spread No. 1
Keystone, Tex., to Pratt, Kans.
b. Spread No. 2
Pratt, Kans., to Mankoto, Minn.
c. Spread No. 3
McPherson, Kans., to Macon, Mo.
Mankato, Minn., to Pine Bend, Minn.
d. Spread No. 4
Macon, Mo., to Janesville, Wis.
e. Spread No. 5
Artesia, New Mex., to Midkiff, Tex.
f. Spread No. 6
Perkins, Tex., to Stanton, Tex.
g. Spread No. 7
Benedum, Tex., to Snyder, Tex.
Tatum, N. M., to Lovington, N. M.
2. RIVER CROSSING SPREADS
1. STATION AND TERMINAL CONSTRUCTION
a. Southern division
(1) Hobbs/Seminole station and terminal
(2) Levelland, Tex., station
(3) Tulia, Tex., station
(4) Skellytown, Tex., station
(5) Beaver, Okla., station
(6) Wellsford, Kans., station
(7) Conway, Kans., station and terminal
b. Northern division
(1) Linn, Kans., station
(2) Greenwood, Neb., station
(3) Sanborn, Ia., station and terminal
(4) Pine Bend, Minn., terminal
c. Eastern division
(1) Eskridge, Kans., station
(2) Kearney, Mo., station and terminal
(3) Moberly, Mo., terminal
(4) Iowa City, Ia., station and terminal
(5) Janesville, Wis., station and terminal
2. DISTRIBUTION LINES
a. Conway to Skelly, Co-op and security underground storage
b. Hutchison, Kans., to Cities Service, Sinclair and Tulsma underground storage
3. PLANT TIE-INS AS REQUIRED BY MID-AMERICA.
4. VHF COMMUNICATION

TEAMWORK AND SPEED were essential in the design and construction of the Mid-America pipeline. Williams Brothers provided for both by setting up the organization diagrammed above. It involved some 1,100 people. And it worked—pipe laying began less than 3 weeks after the go-ahead was received. It was made possible by planning to start design, surveys, right-of-way acquisition, and material procurement the moment notice to proceed was given.

How Mid-America was built

The Mid-America Pipe Line includes a number of features representing advanced modern practice:

- Flexibility of underground storage at junction points. Operations at McPherson, branch point of the line, call for the storage to float on the line.
- Remote control of all pumping units.
- Remote initiation of all terminal deliveries by the dispatcher in Tulsa.
- Use of capacitance probes as interface detectors.
- Use of turbine-type meters at terminals.
- Use of piston-type provers.
- Use of a new type of combination metal-O-ring gasket at flange connections.
- Open-air stations and terminals.
- Pressure controllers with proportional and automatic reset control functions.
- Extensive use of telemetering and data logging.
- Combination blowdown-drain system, for use either with natural gasoline or propane.
- Custody transfer with digitally recorded meter readings and remote dispatcher reading when desired.

These and other important features of the line are covered in this section on design and operation of the line.

1. Control is centered for best operation

The entire line is regulated by dispatcher from 28-in. pushbutton console in main office.

MODERN electrical design for pipeline operation must meet two criteria: Continuous, reliable service, and ease of programed and emergency maintenance. The control system on the Mid-America pipeline incorporates these features and is equipped for future expansion with a minimum of redesign or revision.

The originating pump station on each leg of the main-line system is located at a storage terminal, and four booster stations are adjacent to distribution terminals. Under normal operations, the dispatcher will have remote control of all pump stations. Attending personnel at Hobbs and McPherson control the booster pumps and valves which serve the pipeline, but the dispatcher normally controls the pump station. Operating personnel at the truck terminals will not normally exercise control over the adjacent booster, except as directed by the dispatcher.

Protective devices. At the main-line pump stations the following protective devices are installed:

Electrical: (1) low 2,300 volt a.c.; (2) reverse phase a.c.; (3) low instrument supply; and (4) low station battery.

Mechanical: (1) low suction pressure; (2) high case pressure; (3) high discharge pressure; (4) low flow; and (5) scraper arrival.

These devices serve to shut down units and prevent restart until the fault has cleared. The shutdown relays can be manually reset or can be remotely reset by the dispatcher.

In addition to the above, each pump unit is equipped as follows:

Motor: (1) overcurrent; (2) overload; (3) current unbalance; (4) high winding temperature; (5) high bearing temperature; and (6) incomplete sequence.

Pump: (1) high pump case temperature; (2) high bearing temperature; (3) seal failure; and (4) excessive vibration.

These devices shut down and lock out the protected unit. Operation of any of these indicates a serious mal-

function which requires attention from maintenance personnel. Consequently a lockout from any of these devices can only be reset manually. At unattended stations an annunciator drop will record the cause of shutdown. At attended stations an alarm and flashing red light indicate the source of trouble.

Station controls. Standard sequence operation of suction and discharge valves is used in start and stop control of pump units.

Miniature solid-state, electronic controls are used throughout the system for pressure and load control. Electro-hydraulic actuators operate control valves. Fig. 1 is a typical station-control diagram.

A typical unattended pump station control system consists of: (1) suction and discharge pressure transmitters, (2) suction and discharge pressure controllers, and (3) autoselector device to automatically switch to the control valve the pressure controller that is in a control zone.

Pressure controllers have proportional and automatic reset control functions. To improve suction pressure control response, an "antireset windup" device is used. This device keeps the proportional band centered on the set point regardless of the length of time that suction pressure is satisfactory. Then, when suction pressure falls, the suction pressure controller begins to take corrective action as soon as the proportional band is entered. This permits the suction controller to more closely follow pressure variations, and prevents suction "undershoot" on startup or extreme pressure dip.

To increase system throughput, provisions are made for two operating set points on the suction pressure controller at each pump station. These are preset for the operating suction pressure desired for the product in the pumps. The dispatcher can remotely switch the suction controller to either set point.

Separate instruments are installed to digitally encode pressure data for telemetering. Local recorders are not used, as suction, case, and discharge pressure from each station is telemetered to Tulsa and recorded there.

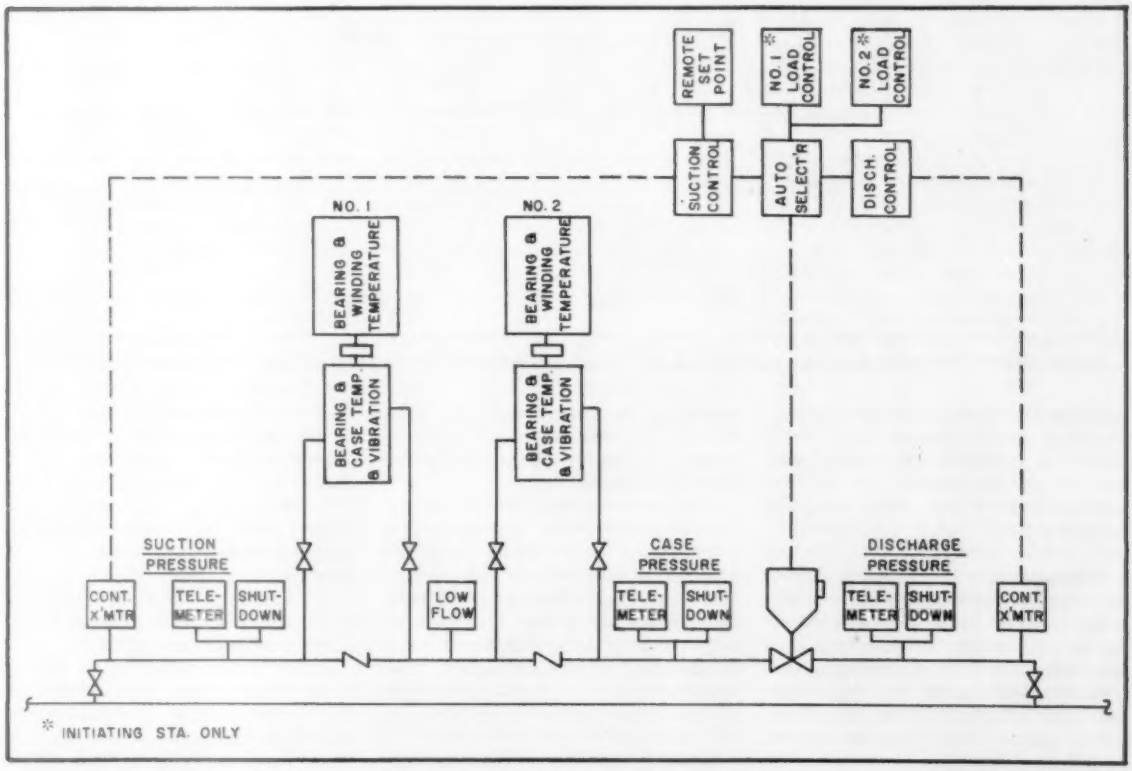
At the originating station on each leg of the line, Hobbs, Conway-East, and Conway-West, load control is used in addition to pressure controls. Load control is installed on both pump units at each of these points, and provides a method of flow control in addition to load control.

Control indications. The Tulsa dispatcher can perform the following control functions at each pump station: (1) stop or start each unit; (2) reset nonlockout shutdown of any unit and restart; and (3) change suction-pressure-control set point.

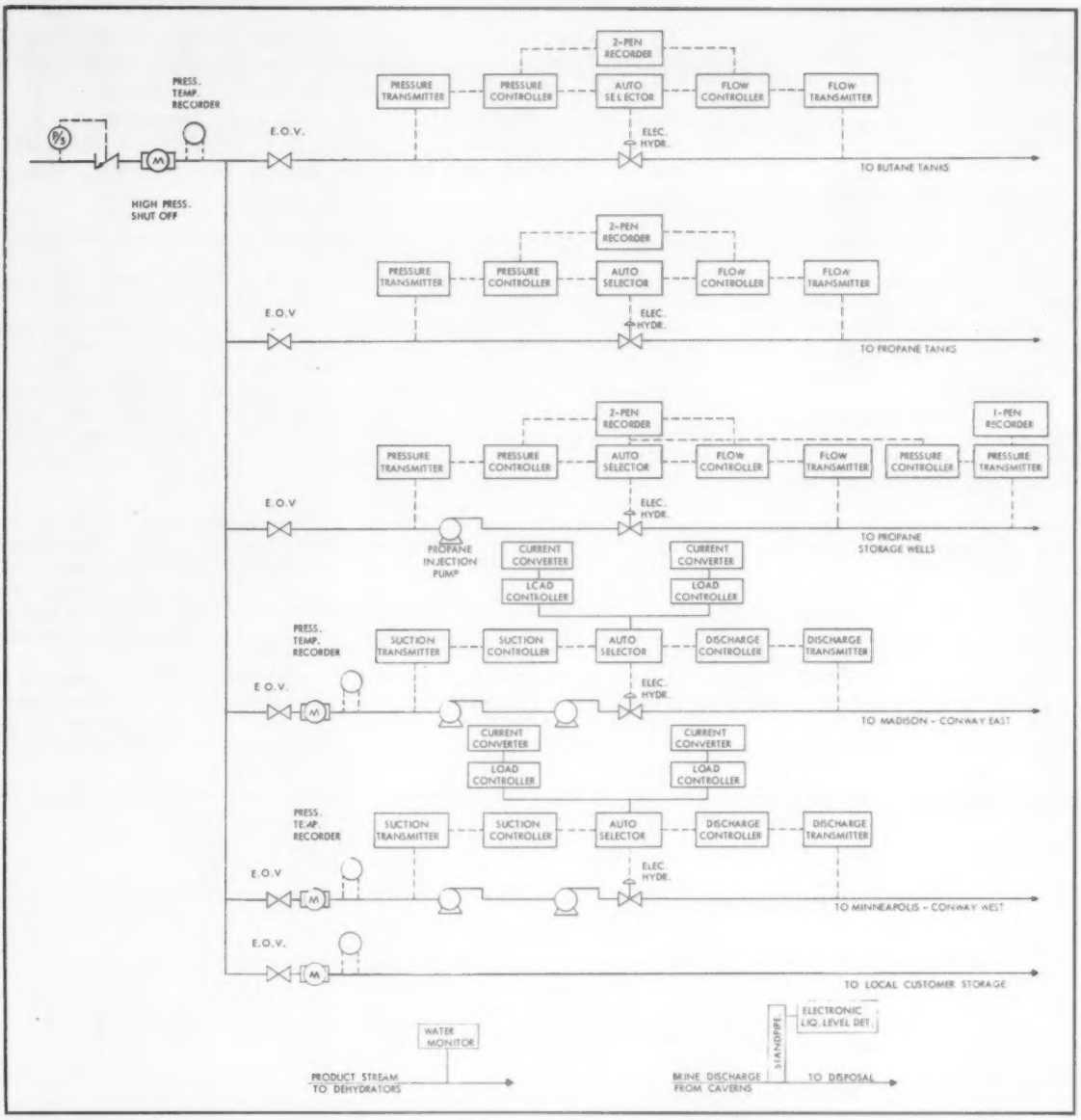
Supervisory indications returned to Tulsa show: (a) ON-OFF condition of each unit; (b) disagreement of any unit (nonlockout shutdown); (c) lock-

The Authors...

All accompanying articles on operating phases of the Mid-America Pipeline were prepared by these engineers on the staff of Williams Brothers, which designed and built the system: G. H. Beck, C. T. Brandt, M. C. Callahan, J. E. Donnigan, G. E. Mace, I. H. Ricketts, J. W. Smith, R. F. Stephens, J. R. Wall and C. H. Ward, and by D. A. Roach, vice president, Mid-America.



MINIATURE, SOLID-STATE, electronic controls regulate pressure and load. Here's a typical station diagram. Fig. 1.



INSTRUMENT CONTROLS for the operation of six lines with different functions at the McPherson terminal. Fig. 2.

out-type shutdown with indication of electrical or mechanical fault (field seizure of control appears as an electrical fault); (d) high or low suction-pressure-control set point; and (e) scraper arrival.

Telemetering. Line operating pressures and meter readings are digitally telemetered to Tulsa and displayed on the control panel. Telemetering does not follow the gradual changes in line pressures but reports any significant pressure variation from the last telemetered value. Meter readings are reported on completion of deliveries or on call basis only. This prevents crowding the communication lines with useless data and significantly reduces the number of communication channels required.

The remote-control and telemetering equipment uses pulse-code-type transmission over leased telegraph grade channels. Each transmission consists of exactly 24 steps of long and short pulses which must be completed within a certain time. Different levels of security are provided against false operation due to communication-line interference or equipment malfunction.

Security checks. The security checks provided to the various functions are as follows in this system:

1. Control functions: (a) total pulse count; (b) parity check; (c) address check; and (d) unique pattern check.
2. Telemetering functions: (a) total pulse count; (b) address check; (c) unique pattern check; and (d) noise discrimination check.
3. Indication functions: (a) total pulse count; (b) address check; and (c) noise discrimination check.

Every transmission, both to and from the field, must successfully pass the test of its class or it will be rejected. Should a garbled control signal from Tulsa arrive at a field station, it will be rejected and no control func-

tion will occur. The dispatcher will be notified by an invalid signal transmission light. Any transmission to Tulsa from the field must pass its security checks before it will be accepted by the Tulsa equipment.

Top priority. Transmissions for the different functions have varying levels of priority. Control has the highest priority, and data telemetering the lowest.

Consequently, data telemetering will wait until all control and indication transmissions are completed.

The Tulsa control panel will permit the dispatcher to perform all operations from one point in the room. A series of data display panels, each about 15 in. wide, are arranged in a semicircle in front of the dispatcher's desk. Each pump station is represented by a data panel, and blank panels are provided for future pump stations in the order of their location. All data pertaining to a pump station are displayed in digital form on its individual panel. The digital code wheels also provide permanent data storage, so the information will not be lost during a total power outage on the Tulsa board.

The entire pipeline is controlled from a 28-in.-wide push-button console on the dispatcher's desk. A station is selected by pushing one button and a control operation or a request for data is initiated by pushing one of another series of buttons.

Data logging. Two electric typewriters handle all data logging. One machine records pressure data and the second meter readings. Data can be read out of the storage units and logged at the dispatcher's request. It will also be automatically logged out during the periodic system roll calls.

Normally, all deliveries from the mainline to distribution terminals are remotely controlled by the dispatcher. However, they can be initiated locally by operating personnel.

All terminal deliveries are made through turbine meters. The meter reading is digitally recorded on a counter mounted on top of the meter. The data are also electrically stored in a matrix of counting relays at the delivery point, and can be read out by the dispatcher at any time. Counting relays were used in preference to stepping switches or mechanical storage equipment to obtain greater reliability and longer component life. This feature and the digital meter preset function are unique to the Mid-America system.

When the dispatcher makes a delivery he selects the desired quantity on the push-button console. When the delivery is to commence he sends this information to the delivery point in a digital code.

Delivery sequence. When this code is received, the following delivery sequence begins:

1. The meter preset code is stored in a bank of storage relays.
2. The meter counting relay matrix is reset to zero, and then read out into data storage relays.
3. The new meter reading (zero) is returned to Tulsa to assure the dispatcher that the meter was correctly reset.
4. The electrically operated delivery block valve is opened, and the delivery begins.
5. An indication is sent to Tulsa that the valve has opened and a delivery is under way.

Pulse rating. As the delivery proceeds, an electric contact on the meter gives one pulse for each 10 bbl. delivered. These pulses are counted by the counting relay matrix. When the total pulses counted equal the value stored on the meter preset relays, the delivery is terminated by closing the electrically operated valve. When the valve is fully closed, the total delivery (to the nearest 10 bbl.) is digitally telemetered to Tulsa. There it is displayed on the control panel and subsequently logged out on the next general roll call.

An indication that the valve is closed and the delivery completed is also sent. If a power outage should occur during a delivery, the delivery line is shut in to prevent overfilling the tanks or bleeding down the main line. This is accomplished in a unique manner. A mechanically latched check valve with 48-volt d.c. trip is installed in the delivery line, opposed to the direction of normal flow. The check valve is located downstream of the terminal delivery valve, and remains in the "latched open" position at all times.

If a power outage occurs while the block valve is open, a pneumatic timer is released. If power is not restored before a preset time of about 10 seconds, the mechanical latch is tripped by the electric solenoid operated from the station battery power supply. This releases the check valve flapper which is closed by the stream flow from the main line. When power is restored, the electrically operated delivery valve automatically closes, and the meter reading is transmitted to Tulsa. The check valve must be manually reset before the delivery can be resumed.

Storage terminals: Miniature solid-state electronic recorder-controllers are used at the storage terminals for back pressure and flow control. The product stream entering a storage terminal can be simultaneously directed to aboveground storage, to underground storage, or to the pipeline. To prevent products from flashing within meters or in the yard piping, instrument controls are used on each product system.

Mechanically latched, electrically tripped safety check valves are installed in each incoming line, opposed to the direction of stream flow. If the incoming pressure on any line rises above the rating of the yard piping, a pressure switch will trip the check valve latch and the stream flow will close it. The check valves will also trip on the terminal emergency shut down circuit.

High-pressure ground-reading tank gages are installed on the storage tanks. High and low tank-level controls for alarms and booster pump controls are derived from cam-operated switches installed on the gage heads. The gages are equipped with liquid-level digital transmitters which read out on the control panel.

Interface detection. Interface arrivals at Hobbs and McPherson are detected by capacitance-type analyzers mounted at the incoming scraper traps. Panel-mounted recorders with alarms announce the arrivals, and give 24-hour records of interfaces. To prevent foreign material from fouling a detector unit, a plate-type measuring probe is used. It consists of several parallel plates with insulating spacers and is mounted on a 6-in. blind flange. Each probe is installed in the downcoming line from the scraper trap with the plates parallel to the direction of stream flow.

The same detector unit is used for the capacitance-type water monitor directly ahead of each product dehydrator. This instrument gives an alarm when free water enters the dryer, as occurs when a storage cavern is "overemptied." This prevents saturating the dehydrator bed with free water and averts unnecessary dryer-bed replacement.

Excess product in the water-discharge line from the caverns is measured by a capacitance-type liquid-level detector. A closed standpipe is installed on the water-disposal line. Normally the pipe stands full of water. However, when product enters the water-disposal line, it will displace the water from the standpipe and uncover the level sensing probe. This gives a large change in capacitance measurement and operates the instrument which gives an alarm at the control panel and shuts down the injection pump.

Distribution terminals: Flow into

terminal storage from the main line is controlled by a throttle valve located downstream of the delivery turbine meter. The valve is controlled by a pressure controller, a flow controller, and an autoselector.

The pressure controller protects the suction of the main-line pumps located adjacent to the delivery point. At terminals not located near booster pump stations, it prevents bleeding down main-line pressure. One pressure transmitter measures main-line pressure for both the terminal delivery and the pump-station suction-pressure controllers. Flow control is used to permit stripping the stream at a controlled rate while pumping past the terminal. The flow-control rate is manually adjusted by the terminal personnel as directed by the dispatcher, as the dispatcher does not have remote-set-point reset control of this instrument.

Each storage tank is equipped with a high-liquid-level control switch operated by a ground-reading tank gage to prevent overfilling. The high-level switch on each tank is wired through a limit switch on that tank's fill valve. To prevent overpressuring the tank fill valves, which are of a pressure class less than maximum main-line pressure, the fill valve limit switches are wired into the controls of the delivery block valve. Before the delivery can begin, the fill valve to at least one tank must be open, and the tank must not be full. Conversely, should a tank be filled, or should all the tank fill valves be closed during a delivery, the delivery block valve will automatically close, terminating the delivery.

Terminal controls. All positive-displacement and turbine meters are equipped with pulse generators for meter proving. The meters are also equipped with electric pulsing contacts for local and remote meter reading.

Turbine meters on all lines entering and leaving storage terminals are equipped as follows:

1. Each has contact to operate its remote digital counter mounted on the control panel.

2. Each main-line meter has a contact which gives one pulse for every 10 bbl. These pulses operate counting relays in the supervisory control equipment. The total meter reading is telemetered to the dispatcher on demand.

3. The gathering-line meters at Hobbs and the local delivery meter at McPherson are equipped for flow rate indication. Each has a 2,000-pulse per barrel pulse generator which feeds a solid-state amplifier. This instrument measures the frequency of the input signal. Its output is a d.c. current signal proportional to the frequency of the a.c. input. The d.c. output feeds a meter calibrated in barrels per hour. A linear flow rate indication is thus obtained, and many of the disadvantages of orifice flow meters are avoided.

4. Distribution terminal delivery meters have a contact which gives one pulse for every 10 bbl. These pulses operate the counting relays for delivery control.

Expansion. The electrical system has sufficient capacity to handle the future requirements of the pipeline as they can best be determined at this time. All future possibilities, of course, could not be anticipated. To meet these ultimate growth requirements, wherever possible, the design has been kept "open-ended" to accept the future expansion with a minimum of redesign and engineering.

2. All pump units are standardized

THE DESIGN of the pump stations follows the general concept of engineered economy. As far as possible, the pump stations use conventional pipeline equipment and design to reduce capital expenditures.

Many of the main pump units were installed initially destaged to provide for easy expansion. These will later be increased to their full number of stages. The following units were installed:

Pump station and pump—	Motor (hp.)
Hobbs, Levelland, and Tulia:	
One 6 by 6 by 11—6-stage	700
One 6 by 6 by 11—4-stage*	700
Pampa, Beaver, and Wellsford:	
One 8 by 10 by 12½—6-stage	1,000
Conway (N.), Conway (E.), Linn, and Eskridge:	
One 4 by 6 by 9—7-stage	600
One 4 by 6 by 9—5-stage*	600
Greenwood:	
Two 4 by 6 by 9—7-stage	600
Sanborn:	
Two 4 by 6 by 9—5-stage*	600
Kearney:	
One 4 by 6 by 9—7-stage	600
One 4 by 6 by 9—6-stage*	600
West Branch:	
One 3 by 6 by 9—9-stage	350
One 3 by 6 by 9—6-stage*	350

*Destaged units.

One pump rotating unit can be used as a spare for 14 main pump units.

All main-line pump units are equipped with 600-psi. ASA suction flanges and 900-psi. ASA discharge flanges. The pumps were hydrostatically tested to 2,400 psig., one and one-half times the maximum operating pressure anticipated.

The pipeline operating pressure maximum is 1,440 psig., the maximum working pressure of the main-line valves and fittings.

Plans for future expansion include: replacing the stages removed on pumps; adding pumps at existing stations; changing sets of impellers; adding stations; or combinations of these. In no case will initial equipment be made obsolete by volume increases.

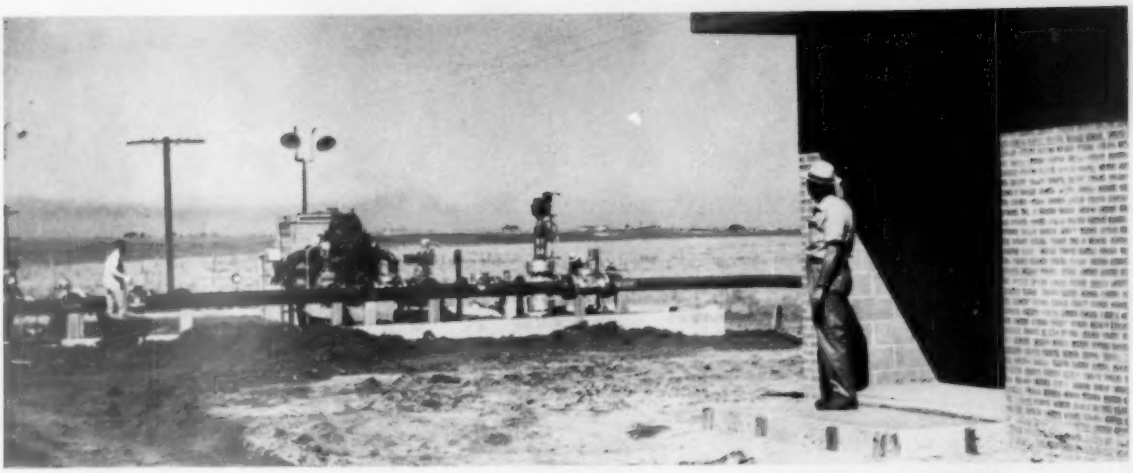
Hydraulic Calculations

Hydraulic calculations were made using the flow formula especially designed for the Mid-America system. This formula and the accompanying calculation procedure were developed to standardize flow calculations and provide a quick and accurate method for checking computations. The formula was developed from the basic D'Arcy relationship using a friction factor based on the Colebrook-White function using an absolute roughness of 0.0007 in.

A small computer was used to tabulate Reynolds' number and the Von Karmon number versus friction coefficients for various sizes of pipe. Once perfected, this method proved to be extremely effective. All design personnel were quickly and easily trained to use the standard forms and tabulated data.

The design included provision for expansion by increasing the facilities at existing pump stations and by adding intermediate stations.

The mechanical seals were designed to operate with 1,000-psi.-differential pressure across the faces with minimum leakage. This allows the seals on the second of the two pumps in series to operate without extra piping to re-



PAMPA, TEX., STATION with building for office and switchgear in the foreground and open air, pumping unit and station piping beyond. Like other stations, this will be remotely controlled from the Tulsa office.

duce pressure points at the station.

Mechanical seals have a close-fitting bushing on the outside of the seal proper. The space between the mechanical seal and the throttle bushing is fitted with a pressure switch. In the event of seal leakage the pressure between the mechanical seal and the throttle bushing will build. When the pressure switch closes, a shutdown circuit is initiated which stops the pump unit and closes the motor-operated suction and discharge valves. All valves used in the pump stations are of the resilient seat type to insure positive shutoff on closing.

Drains and Blowdowns

In the design of scraper traps, strainers, and drain piping for an LPG pipeline, it is important to consider that propane will vaporize rapidly if not held under sufficient pressure at any temperature that could normally be expected. Isobutane, butane, and the family of natural gasolines will also vaporize rapidly if the temperature is high enough. At normal temperatures, however, natural gasolines will not vaporize rapidly, so that facilities must be designed to drain as well as to "blowdown." A combination blowdown-drain system was designed to permit operations of these facilities with either type of product in the system.

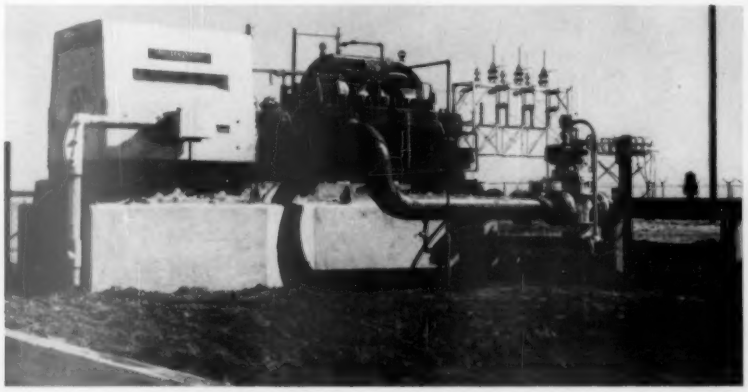
Gaskets. One of the weak points in most station piping has been the flanged connections. Efforts to eliminate flanged connections by using weld-in valves entirely is impractical since any minor change in piping would require "hot" work.

A new metal gasket with a synthetic rubber O-ring on each side was used to reduce the hazard of the flanged connections. This gasket provides metal-to-metal surface contact between the flange and gasket as well as the O-ring seal. Effectiveness of the gasket was tested. A 6-in. 600-psi. ASA raised face flanged connection was tested hydrostatically. One of the flanges had a relatively deep scratch across its serrated face. Even under these adverse conditions the connection did not fail until reaching 5,950 psig. Most interesting was the fact that the connection resealed bubble-tight when the pressure reduced to 4,000 psig. This indicates that the flange distorted and failed rather than the gasket.

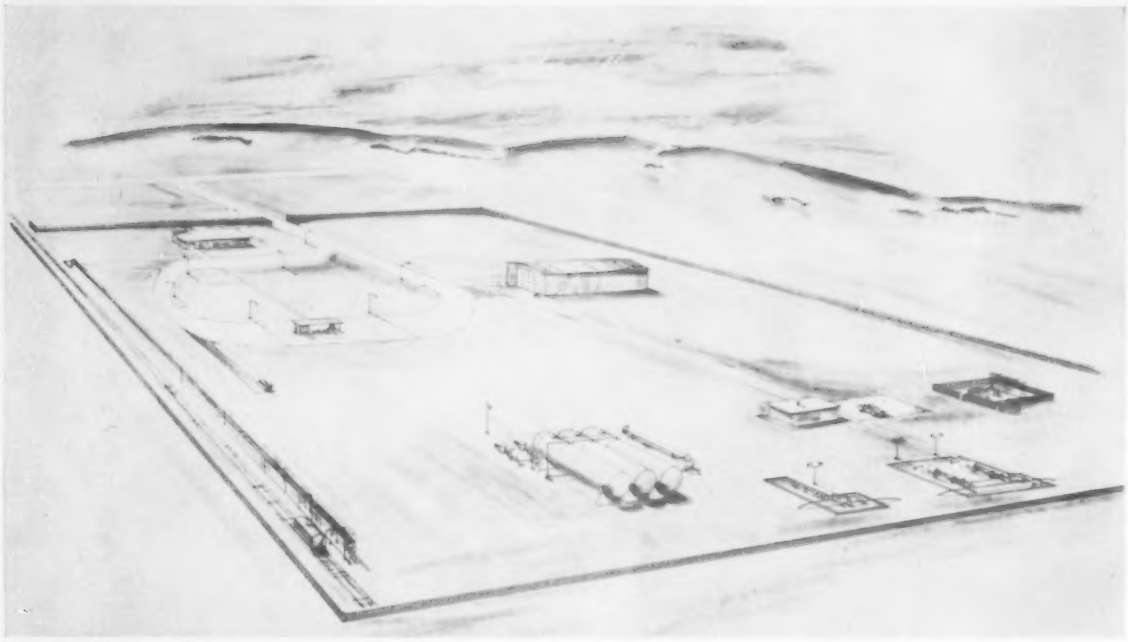
Other tests conducted by the manufacturer have carried the test pressures much higher using flat face flanges and raised face flanges, without serrations on the raised face.

Standardization. As much standardization as possible was used to reduce maintenance costs and the cost of warehousing spare parts. Four different size pumps were finished by the two manufacturers. This was due to the different heads and capacities required in the various line sections. In spite of this, however, only one size and type of mechanical seal is used throughout the system. Motor-frame sizes were standardized so that only one size of motor frame is required for horsepower from 600 to 1,250. This makes possible the shifting of motors between pump units at the lowest possible cost.

One pump rotating element can be used as a spare for 14 main pump units.



TYPICAL outdoor remote-controlled electric-centrifugal pump installation at Pampa station.



ARTIST'S CONCEPTION of Sanborn terminal shows storage, tank and truck loading, warehouse, and office.

3. Operating terminals are flexible

This terminal can deliver three products, receive one, and "split" incoming stream simultaneously.

THE MID-AMERICA SYSTEM has two main operating terminals, one near Hobbs, N. M., and the other near McPherson, Kans. These terminals are very similar in that each has aboveground tankage, underground storage, meter facilities, and main-line pump stations.

Hobbs is the beginning of the main line and is fed by three separate gathering systems. Its primary function is to combine batches of products from the gathering system into tenders for movement north into the main line. Underground storage is to assist in leveling out seasonal peaks.

McPherson is the terminus of the 10-in. main trunk. Here the system splits into two 8-in. lines which serve Pine Bend (Minneapolis) and Jamesville (Madison). A short spur serves three underground-storage plants.

Terminal function. The primary function of McPherson terminal is to receive and store products from the producing area for movement into the marketing area at rates necessary to satisfy seasonal demand.

Piping, metering, manifolding, and tankage are very similar at both terminals. A central manifold system can handle four products initially and six ultimately. The initial products are propane, isobutane, normal butane, and natural gasoline. Tankage is available for propane and normal butane only, with provisions to add storage for additional products as the need arises.

All four incoming and outgoing streams are monitored with turbine-type meters. Meter readings to the nearest barrel are electrically transmitted to the control building. A two-pen recorder is located adjacent to each meter run for use in correcting all readings for compressibility and temperature.

The various meter runs are tied together with a continuous loop into a 24-in. prover vessel. A bidirectional piston-type prover was selected because a closed system was considered essential in high-vapor-pressure service. It is also more desirable because of its ability to prove "on stream" thereby eliminating the need for oversize booster pumps and the attendant main-line fluctuations. The prover barrel is adequately sized to give good accuracy for all rates anticipated. The vessel was shop calibrated at 200 psi.

Meters are equipped with tach generators which develop 1,000 pulses per barrel. Proving is accomplished by comparing the known volume of the prover vessel to an electronic counter which is driven by the tach generator.

Manifolding and Switching

Fig. 1 is a schematic diagram of the central loop manifold at McPherson. The loop system was selected as the best over-all approach to control contamination and still provide maximum flexibility. The loops are arranged in order of descending vapor pressures for arriving shipments. Upon receiving an interface into the terminal the switch to the correct product loop is of first consideration.

This switch is controlled from the office console panel and facilitated by interface detection instruments located on the incoming scraper traps and motor-operated plug valves. Line-up for various operations (i.e., to

tanks, to underground, to outgoing pumps) can be made manually prior to actual arrival of the interface. In this manner, it is possible to catch all cuts in a minimum number of places.

No provision for transmix was provided as it is planned to take "heart cuts" on propane which has the most critical specification and end cuts on all other tenders.

Sweepouts used. In some cases such as meter proving, it is possible that the vessel may be "laid down" with the wrong product. In order to solve this problem, sweepout connections which lead back to the loop manifold were provided. This allows the contents of the vessel to be displaced into the tanks when the system is refilled with the correct product. To prevent contamination in the dead space of bypasses, the block valve was located on the upstream end of the bypass and a check valve on the downstream end. This isolates the bypass under normal conditions and allows it to be left blown down and free of product.

All header valves separating different products are fitted with body bleeders and can be checked against either upstream or downstream leakage. Fitting makeup was used as often as practicable in all headers to reduce contamination. Wherever possible, combination plug-check valves were used in the interest of economy.

Flexibility. Close examination of Fig. 1 will show that flexibility of operation is the keynote. It is actually possible to perform all the following operations at McPherson simultaneously:

1. Receive dry propane from main incoming 10-in. line into aboveground tankage.
2. Deliver isobutane to Conway shippers from aboveground tankage.
3. Deliver wet propane from underground storage directly through dehydrators to Janesville line.
4. Deliver wet normal butane from underground storage directly through dehydrators to Pine Bend line.

In addition to the above full-stream operations, it is also possible to "strip or split" streams. For example, if the incoming propane stream is to be "floated" through the tanks, the propane delivery control valve can be adjusted to hold sufficient back pressure to insure that no flashing will occur in the meter runs and provide adequate suction pressure for the main-line units. This is very important when opening up into a cold or empty tank.

Underground Storage

Underground storage is the aqua type where the cavern is completely full of liquid and under pressure at all times. Water fills any void not occupied by product. Since product is lighter than the brine, there is a considerable static head differential in the well, which must be overcome during product injection. A 600-hp. electric centrifugal injection unit can put down 90,000 bbl. per day. Control for lesser rates is afforded by a discharge control valve and a suction-pressure controller. Three underground caverns of 27,000 bbl. each are presently developed and tied into a centrally located manifold. This manifold makes it possible to operate the caverns in much the same way as aboveground tankage.

A 150-hp. water-injection pump is used for product recovery. Different products can be stored in each cavern and can be recovered simultaneously up to a total rate of 90,000 bbl. per day. Water-metering facilities can continuously enlarge existing storage and develop additional caverns.

Water source. A well provides fresh water for both cavern washing and initial operational recovery. When throughput requirement exceeds the capacity of the well, or when fresh water has enlarged the cavern to the maximum, surface brine or water storage, or both, will be constructed. Displaced brine is moved through a settling tank to a disposal well.

There are two complete dehydration systems. Each has a capacity of 53,000 bbl. per day. It is possible to dehydrate separate streams from underground simultaneously for movement into the Janesville and Pine Bend lines. Water monitors are on the inlet and dew-point indicators on the outlet of both dehydrators. Dual towers and a complete regeneration system on each dehydrator make continuous operation possible. Activated alumina is the dehydrating agent and a specification of −40° F. dew point can be obtained.

Aboveground Storage

Six 63,000-gal. tanks are for propane service. They are ASME code stamped for 250-psi. working pressure, 100% X-rayed, and fully stress-relieved. Suction and fill valves are motor operated.

A top equalizer system connects the vapor space of all tanks. This allows free breathing of different temperatures between tanks thereby increas-

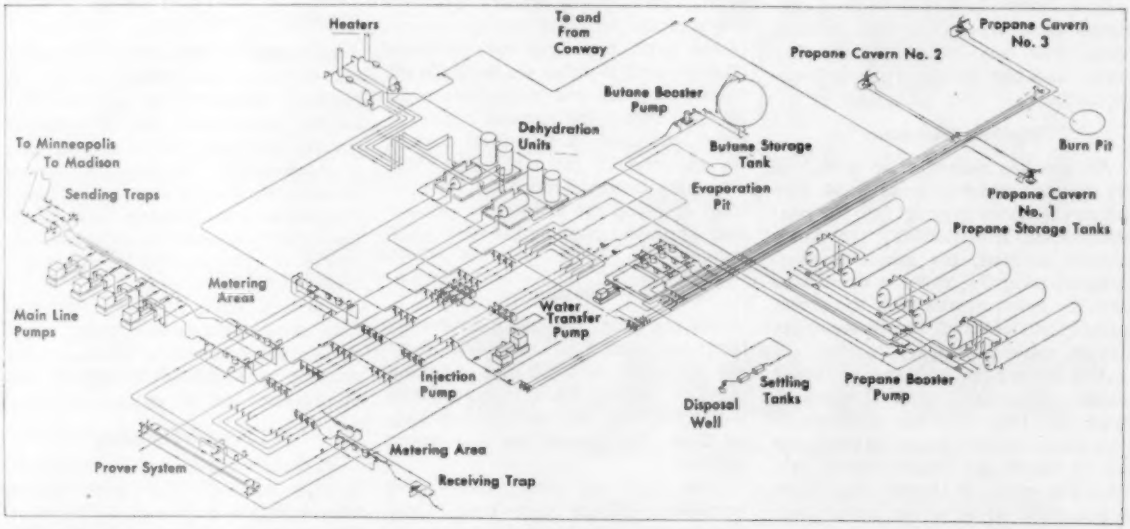


DIAGRAM of McPherson terminal's central manifold showing separate lines or loops assigned to different products so as to avoid contamination. Five product movements can be handled simultaneously. Fig. 1.

ing filling and emptying rates. Filling is from the top through a spray header. This increases the pumping rate by cooling the vapor space and breaking up the liquid surface. All nozzles of all tanks have electrically operated safety check valves. These valves have fusible links for automatic closing in event of local fire and can be closed by a "crash" button on the console panel in the control building. A 75-hp. vertical can-type booster pump transfers product from the tanks to the main-line units.

Butane storage. A 20,000 - bbl. sphere will handle normal butane storage. This tank is ASME code stamped for 60-psi. working pressure and spot X-rayed. Suction and fill valves are motorized and electric safety checks are used as in propane tanks. A 150-hp. vertical can-type booster pump is used to withdraw from this tank.

Hobbs terminal has the same scheme. Aboveground storage, manifolding, metering, proving, etc., are practically identical except in size and quality.

Codes, standards. All tanks conform to the latest ASME code for unfired pressure vessels; all piping to Section 3, "Refinery and Oil Transportation Piping Systems," of ASA B31.1—1955[14]; metering and proving API code 1 101; and over-all design of the terminals was to API standard 2510, "The Design and Construction of Liquefied-Petroleum-Gas Installations at Marine and Pipeline Terminals, Natural Gasoline Plants, Refineries, and Tank Farms."

4. Distribution terminals are uniform

Seven distribution terminals follow same design, layout; similar equipment cuts spare parts.

SEVEN distribution terminals are included in the Mid-America pipeline system. A general design and layout was selected to simplify operations and maintenance. It was changed only slightly to satisfy local conditions. All equipment is interchangeable from terminal to terminal thus simplifying the spare-parts problem.

Greenwood (Omaha) and Kearney (Kansas City) terminals each have two 63,000-gal. propane-storage tanks, one two-spot truck-loading dock, and a five-spot tank-car-loading rack. Moberly terminal is identical to Greenwood and Kearney terminals except that it has no tank-car rack. A district office and a warehouse are located at Moberly.

Loading and storage facilities at Sanborn and Iowa City terminals are identical with three 63,000-gal. storage tanks, a two-spot truck-loading dock, and a 10-spot tank-car-loading rack. Sanborn terminal has a district office and warehouse.

Both Janesville and Pine Bend terminals have five 63,000-gal. storage tanks, two two - spot truck - loading docks, and one 10-spot tank-car-loading rack.

Pipeline Deliveries

All pipeline deliveries to terminals are initiated remotely from Tulsa. The delivery quantity is preset into the control system. Automatically the meter counter is reset, the motor-operated terminal receiving valve is opened to start the delivery, and after the preset quantity is delivered, the terminal receiving valve is closed.

A 1,000-g.p.m. turbine-type meter meters deliveries to each terminal. A pulse generator on the mechanical-type meter counter transmits one pulse per 10 bbl. to the remote-control system. The pulse generator also transmits a pulse signal to the meter-proving system. The turbine meters are not temperature compensated. A pressure-temperature recorder located just upstream from the meter makes it possible to correct the metered volume for temperature and compressibility.

Upstream pressure and flow rate into the terminal are controlled by an electrohydraulic control valve. The terminal receiving system is designed for rates from 300 to 1,000 g.p.m., which may be set to meet the pipeline dispatching schedule. The flow-controller set point must be set locally. The sustained accuracy of the turbine meters over this wide range of flow rates is an important feature.

Unusual conditions at any terminal will stop or prevent a delivery. If terminal power fails and the motor-operated terminal receiving valve will not close, a d.c. solenoid is energized which closes a quick-closing check valve, thus stopping the delivery. The low-pressure terminal piping is protected from high pipeline pressures through limit switches on the tank fill valves. At least one tank valve must be open before the terminal receiving valve will open. A high-level contact on any one of the tank gages will cause the terminal receiving valve to close and stop the delivery to prevent overfilling and popping the tank relief valves.

Storage

Aboveground 63,000 - gal. storage tanks are used at all terminals. They are designed for 200-psig. working pressure and are built in accordance with the ASME Unfired Pressure Vessel Code. The vessels are also stress-relieved.

Two four - port safety relief - valve manifolds protect each tank. Only three ports on each relief valve manifold are exposed to tank pressure at any given time. This feature makes it possible to repair the relief valves without taking the tank out of service.

Each tank is equipped with an automatic ground-reading tank gage. Contacts on the tank gages provide high and low-level protection.

Loading pumps. To meet critical NPSH requirements, can-type vertical turbine pumps were selected. The pumps are designed to operate at 465 g.p.m. and 490 ft. of head with zero net positive suction head at the suction nozzle. The pumps each use eight stages to give a very steep head capacity curve. The pump shutoff head is approximately 1,000 ft.

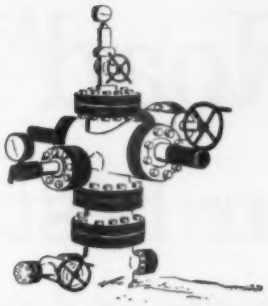
Each pump is protected by a low-flow switch. A low-level contact on the tank gage shuts the pump down when flow drops to 20 g.p.m. and sounds an alarm.

Dehydration. Product in the pipeline will be of specification dryness. A product dehydrator is provided for further protection. The dehydrators are the dissipating chemical type using a compensating cartridge. A spring-loaded plate compensates for desiccant dissipation and prevents channeling. Each cartridge contains approximately 128 lb. of calcium chloride which will remove 256 lb. of water.

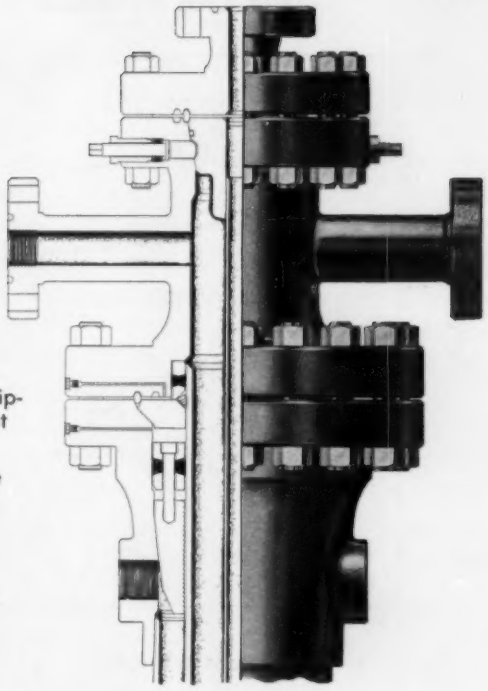
There is also a 5 to 10-μ filter section in the dehydrator. The dehydrators are designed to filter and dry propane at a rate of 500 g.p.m. and at pressures not to exceed 500 psig.

Tank-Car Loading

Tank cars are loaded by the spray-loading method. The 2-in. loading assemblies consist of a steel-pipe swivel arm with a minimum length of rubber hose. A ball valve on the end of each



FOR STORAGE WELLS TOO!



RECTOR SEAL-WITH-STEEL INSURES SAFETY—PREVENTS LOSS

The underground storage of liquefied petroleum gases is becoming increasingly important in solving the problems of seasonal storage of butane and propane gases.

Of vital importance to underground storage is the surface equipment necessary to insure safety of operation, and to prevent loss through leakage after storage wells are completed.

Rector "RH" casing heads and Rector "ML" tubing heads are ideally suited for storage well completions, and for oil and gas wells. The Rector seal-with-steel feature gives positive metal to metal seal, the trademark of Rector's design and safety. Rector *engineering know-how* is available to solve individual problems presented by varied underground storage installations. Rector equipment meets all standards of the API and the Association of Well Head Equipment Manufacturers. Tested to 22,500 lbs. as stipulated in API test specifications.

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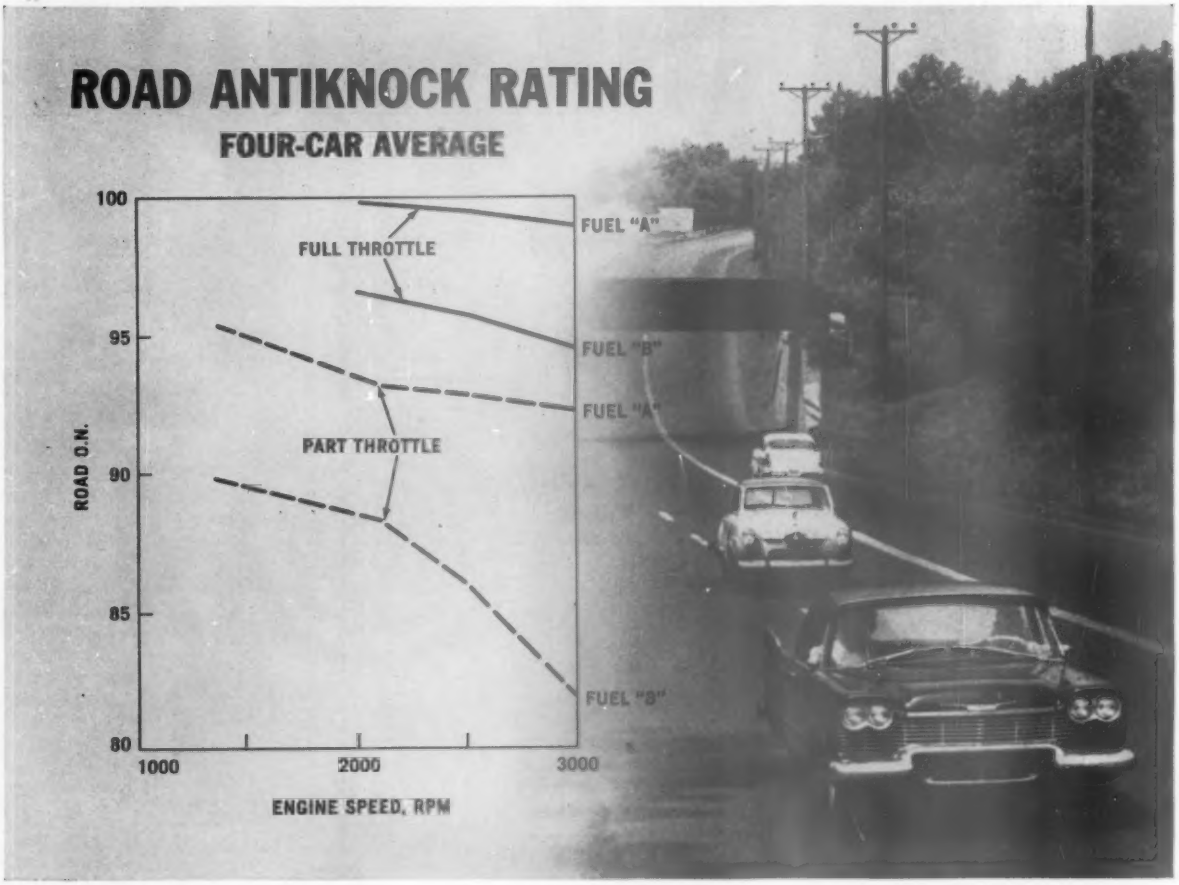

Your customers—passenger car drivers—are the final judges of the antiknock quality of gasoline, by its performance in their cars on the road.

Designing a fuel to a given Research octane number specification by using a higher antiknock compound concentration will result in a road octane bonus which can pay off in terms of customer satisfaction. This is particularly significant when guarding against high-speed or part-throttle knocking problems.

That's why the road bonus that you get from antiknocks—the extra octane, over and above Research and Motor ratings—is so important.

TEL Road Bonus Demonstrated

Road bonus from antiknocks has been demonstrated by tests performed on two fuels of the same hydrocarbon-type composition, and similar distillation ranges and sulphur content. Specific aromatics, olefins and saturates were selected carefully for each blend so that both had the same nominal laboratory octane ratings.

The only difference between the two fuels was

from Antiknocks...

road performance

in TEL content: Fuel A contained 3.0 ml TEL/gal and Fuel B contained no TEL.

Demonstration Fuels

	A	B
Res. O.N.	98	98
Motor O.N.	88	88
% Aromatics	40	40
% Olefins	5	5
% Saturates	55	55
TEL ml/gal	3.0	0.0

Because the beneficial effects of TEL vary with car make and speed, results were based on a four-car average of current models. Test results—charted on the facing page to the left—rated Fuel A (with TEL) from three to five Road octane numbers higher than Fuel B (without TEL). Although not shown in the chart, the increase in road performance is naturally greatest with the addition of the first ml/gal, but—at the other end of the scale—the road bonus continues to go up with the use of a fourth ml/gal.

What This Means to Refiners

As you can see from the chart, the effect of TEL is greatest at high speeds, generally the critical point with modern vehicles and sensitive fuels. Part-throttle operation with certain vehicles also is critical and here the TEL bonus again is significant.

Because of this road bonus, the use of higher concentrations of antiknocks is generally the most economical means of purchasing road performance on a ¢/Road octane barrel basis.

What About the Future?

There are a number of antiknocks and "extenders" now in the development stage. Most of them promise extra quality on the road. Additive octanes from combinations of antiknocks may soon be allocated to various gasoline grades to optimize the road bonus effect at lowest cost.

For additional data on Road octane bonus from TEL, ask your Ethyl Representative for a copy of the SAE paper, "Are Octane Numbers and Hydrocarbon Type Enough?" He will be glad to see that you get one.

REMINDERS TO REFINERS

Antiknocks are your best octane improvement buy, whether costs are figured on Research, Motor or Road ratings.

Antiknocks give you a Road octane bonus you can't get any other way.

Gasoline sensitivity can be decreased with antiknocks.

Refining flexibility can be increased with antiknocks.

Antiknocks also can reduce or delay capital investment in octane improvement equipment.

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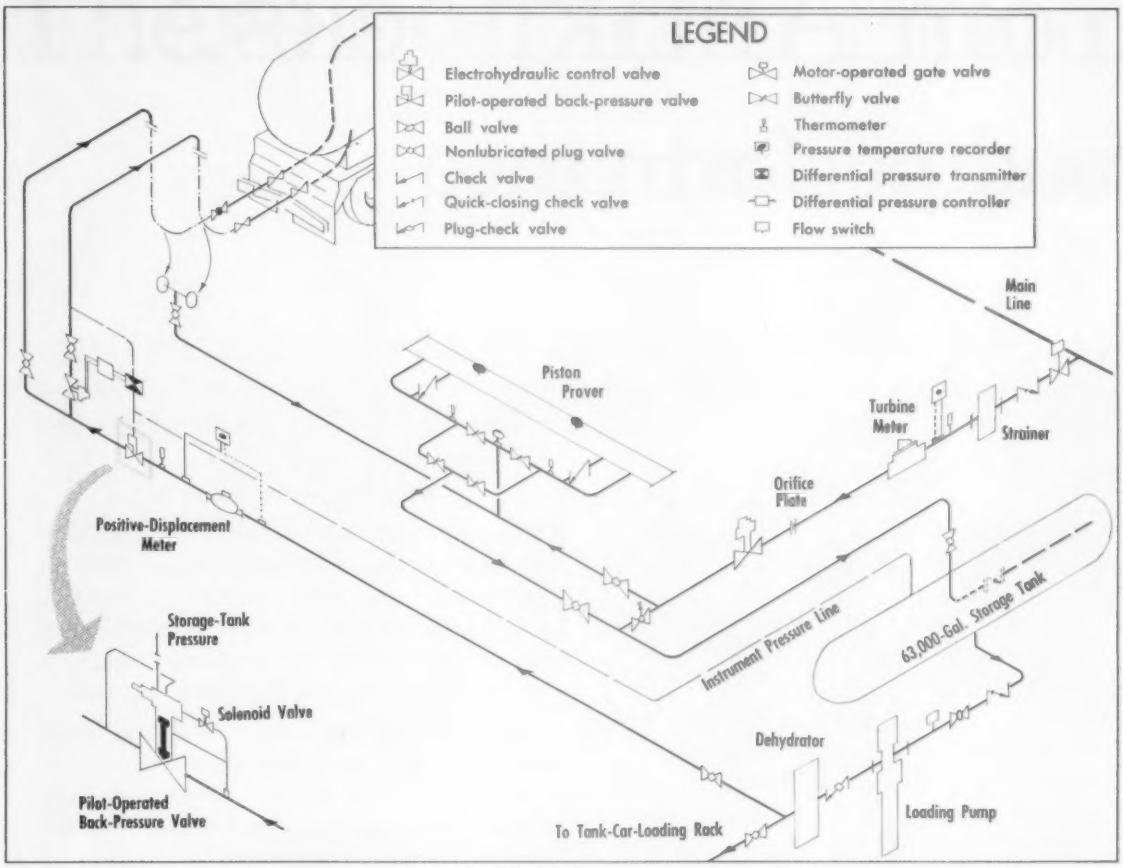


TANK CARS are loaded by spray method, tank trucks by Y-method at distribution terminals.

loading hose eliminates hose blowdown and still keeps the pressure drop to a minimum. Since the loading hoses are continuously filled with liquid propane, a special nonleaching rubber LPG hose was selected.

Tank cars may be loaded with one pump while a truck is being loaded with the other or the loading pumps may be operated in parallel to increase the tank-car-loading rate. The pumps in parallel will load tank cars at approximately 800 g.p.m. per loading rack.

Odorant is injected into the propane at each truck and tank-car-loading spot. The odorant-injection system consists of pressurized odorant storage vessel, distribution piping, and, at each loading spot, a sight glass for measuring the odorant to be injected. Nitrogen pressurizes the odorant tank and forces the odorant through the sight glasses into the propane stream.

Truck Loading

A positive-displacement meter measures each truck delivery. The oscillating piston-type meters have a set stage valve, ticket printer, and large numeral counter. A right-angle drive on the calibrator, turning one revolution per 10 gal., drives a pulse generator for the meter-proving system.

A pilot-operated back-pressure regulator, just downstream of each meter, maintains a minimum pressure of 15 psi. above vapor pressure in the meter. The pilot is loaded by a 15-psi. spring plus storage-tank pressure, thus varying the regulator absolute pressure set point with changes in vapor pressure.

The back-pressure-regulator inner valve is positioned proportionally by a double-acting piston. Upstream pressure is on the top side of the piston at ali times. A proportional pressure from the pilot is applied to the bottom of the piston. The back-pressure regulator may be closed remotely by closing a solenoid valve which blocks the proportional pressure under the piston and bleeds it downstream. Through an electrical circuit to this solenoid valve, the back-pressure valve serves as a set-stop valve and an emergency-shutdown valve.

Four conditions. At the start of a delivery the back-pressure regulator will not open until the following conditions are met:

1. The meter ticket must be inserted in the printer and the initial reading must be printed.
2. The delivery volume must be preset into the meter counter.
3. The loading pump must be on.
4. Pressure in the truck must be below a preset valve.

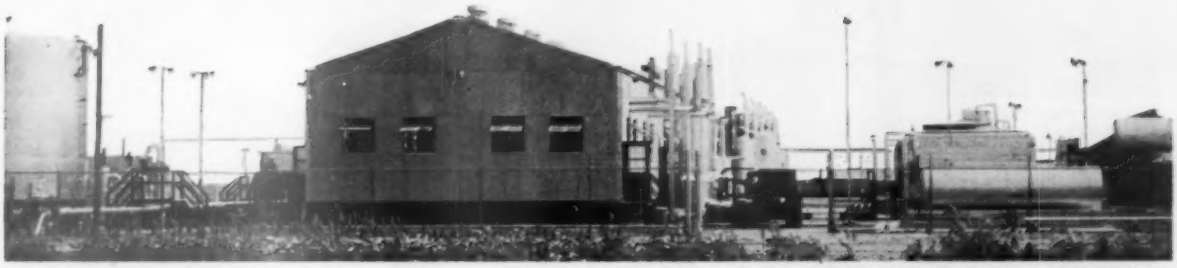
The truck-loading system loads at rates above 450 g.p.m. The Y-loading method with differential pressure control attains these high rates.

In Y-loading, connections are made both to the top (vapor) and bottom (liquid) truck-loading lines. A control valve is installed in the bottom loading line. As the truck pressure increases during loading, the control valve throttles and diverts more of the flow to the top of spray-loading line. The spray loading and slightly reduced loading rates delay the increase in truck pressure which increases the average truck-loading rate. New transports being purchased for operating from Mid-America terminals are being equipped with spray loaders to permit high loading rates.

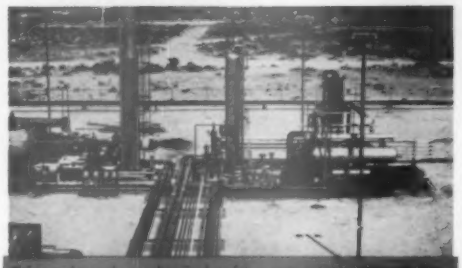
from drawing board to installation . . .

Southwest

specializes in TURNKEY operations



Southwest designed, engineered and installed this prefabricated water pumping station for a Pan American Petroleum Corporation unitized water-flooding operation in Southwest Texas.



This packaged, mechanical refrigeration type natural gasoline plant was built by Southwest on a turnkey contract that included complete process design, and installation engineering for a major oil company in West Texas.

This barge-mounted compressor station, including dehydration facilities and incorporating 1600 h.p. of compression in four units, is utilized in offshore gas boosting for transmission sales by the CATC Group at Grand Isle, La.

A main line boosting for a major gas transmission company along the Texas Gulf Coast is this compressor station of four 660 h.p. packaged integral compressors, built completely on a turnkey contract.

Southwest incorporates engineered, pre-fabricated methods to install unitized facilities — *quicker and cheaper* — for the oil, gas and chemical industries on a turnkey basis. All are API-ASME code constructed.

Southwest's competent staff of mechanical, chemical and civil engineers—all registered as professional engineers with years of experience in this type work—can complete your project months ahead of field-constructed plants. Complete flexibility also enables Southwest to construct to your engineering requirements or to offer custom-designed plants FOB our shops for installation by others.

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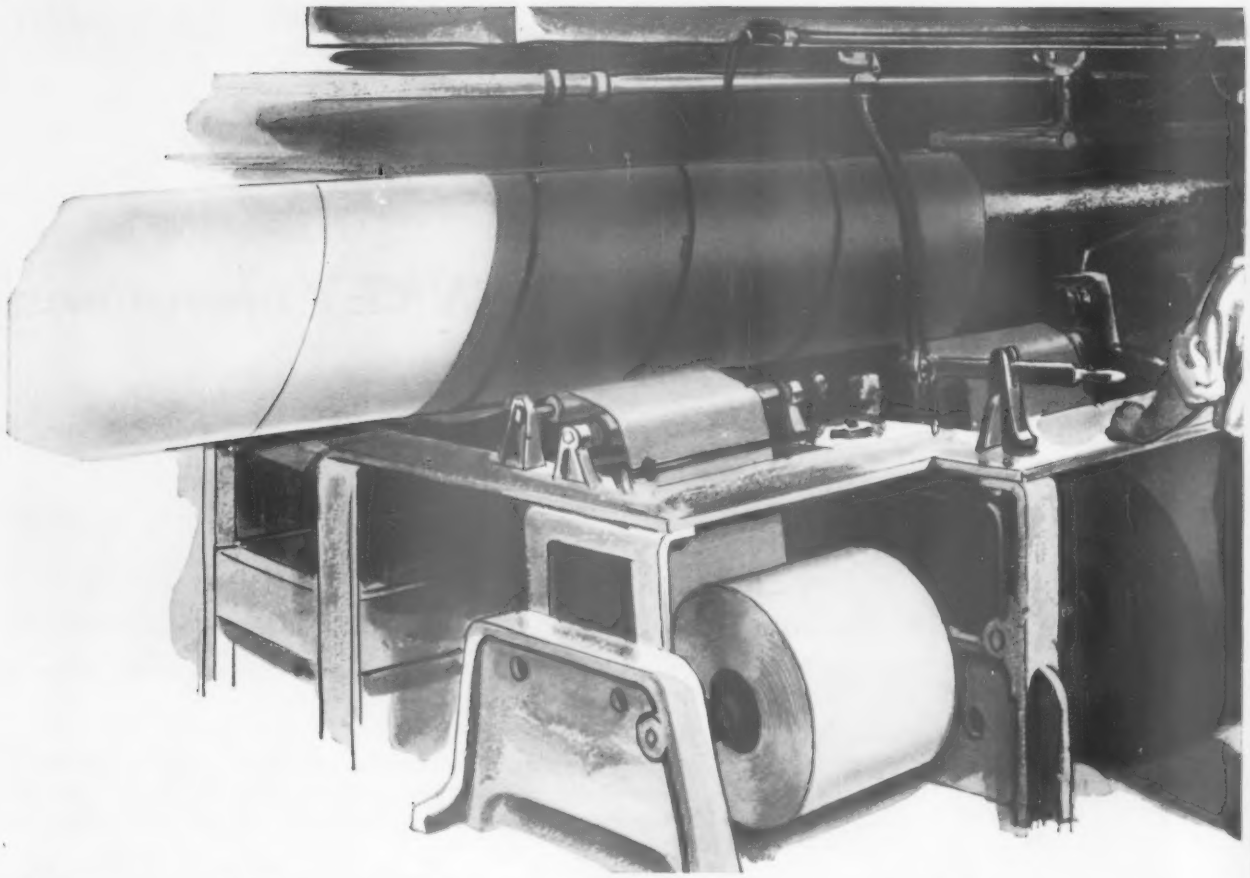

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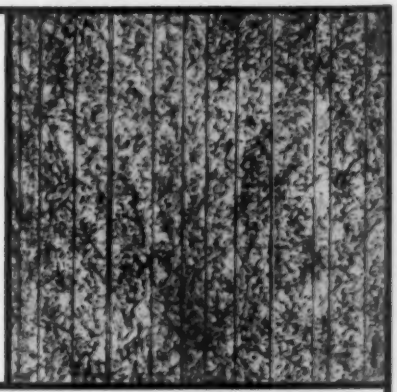
J-M materials used extensively on Mid-America Pipeline Co., LPG line.

MEET **3** PARTNERS IN PIPELINE PROTECTION FROM JOHNS-MANVILLE

1



J-M BLUE FLAG Fiber Glass Wrap is a mesh of reinforced glass fibers that cannot rot, decay or absorb moisture under ground. Blue Flag lets enamel bleed through evenly until the wrap becomes an integral part of the coating. Uniform porosity prevents "holidays" as it assures consistent build-up.

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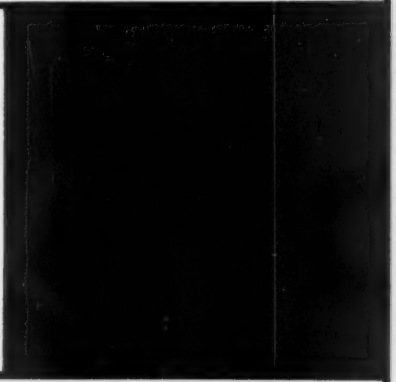
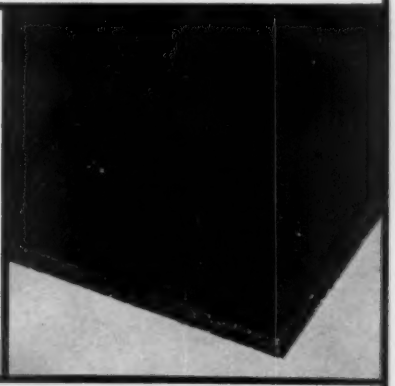


J-M ASBESTOS FELTS, impregnated with either asphalt or coal-tar, are available in several weights to meet varied job requirements. These asbestos felts provide a flexible covering of stone, and have served as a tough outer shell on pipelines throughout the world.

3



J-M FLEXIBLE ROCK SHIELD is an asphalt-mastic composition board with a laminated felt surface. Its flexibility conforms to any pipe size, and its resilience provides the cushioning required in rugged rocky terrain.

- **DEPENDABLE RESISTANCE TO DAMAGE**
  –during handling
  –during backfilling
  –throughout the life of the pipe, J-M Blue Flag plus J-M Asbestos Felts give proven protection against soil pressures and chemicals . . . assure successful, low-cost operation of cathodic protection

- **FOR UNUSUAL CONDITIONS,** there's one more J-M Product you can use–a *third partner in protection*–J-M Flexible Rock Shield. It cushions the lines against rock penetration during backfilling and in service. J-M Flexible Rock Shield provides more dependable, lower-cost protection than dirt-padding, and conforms readily to all pipe sizes.

For further details about Johns-Manville Pipe Wrap materials–*three partners in pipeline protection*–see your nearest J-M Representative, or write to Johns-Manville, Box 158, Dept. OG-1010, New York 16, N. Y.

JOHNS-MANVILLE

BLUE FLAG is a registered trademark of the Johns-Manville Corporation

JOHNS MANVILLE JM PRODUCTS

Rates constant. Differential pressure between the storage tank and truck tank is the controlled variable in the truck-loading control system. Loading pumps operate close to the same point on the performance curve during a greater portion of the loading cycle. This means that the flow rates through the meter are more nearly constant which gives more accurate meter results. With differential pressure control, a lower-horsepower pump is required.

The extreme conditions of starting a delivery into a truck that is at high pressure, say 200 psig., was taken care of by choosing a pump with a steep head capacity curve. This permits low flows at the required high pressure to be loaded through the spray-loading line. The spray loading will lower the truck pressure which causes the bottom-loading-line control valve to open, thus increasing the flow to normal rates.

If the truck pressure approaches the truck relief-valve setting during the loading cycle, a pressure switch closes the meter back-pressure valve to stop the delivery.

Emergency Shutdown

Each terminal is protected by an emergency shutdown system. Emergency shutdown push buttons are located at the truck dock, tank-car rack, and the loading pump area.

A solenoid-operated quick closing check valve is mounted directly on each tank suction nozzle. There is also a quick-closing check valve at the tank-car rack header. The meter back-pressure regulators are used for emergency shutdown at the truck dock. Operating any one of the emergency shutdown push buttons will stop flow out of the tanks to the truck dock and to the tank-car rack. Deliveries to the terminal from the pipeline will be stopped.

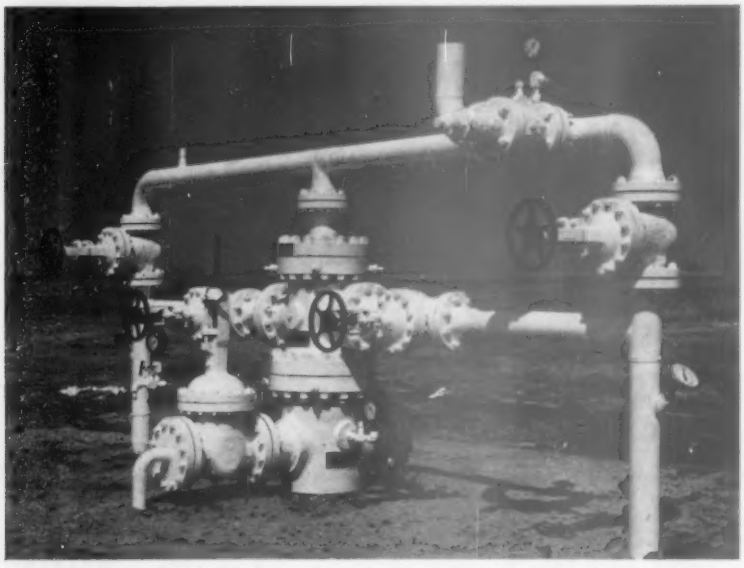
5. Cavern storage used at critical points

Two units at Hobbs, three at McPherson will provide total capacity of 300,000 bbls.

WHEN LPG is one of the products handled by a pipeline, large-volume low-cost pressure storage at critical points is essential. This type of storage can be provided for the least cost in caverns dissolved out of naturally occurring salt deposits.

Mid-America uses such storage at Hobbs terminal where the gathering system ends and the main line begins. It is also used at McPherson terminal where the main line branches and ties into facilities of others. Studies indicated that 150,000 bbl. of storage would be desirable at each location. Both sites are underlain by salt beds and the construction of dissolved caverns was possible.

The Hobbs location is near the center of the Permian salt basin. The log of a dry hole approximately 7,000 ft. from the terminal showed salt in the Salado formation between 2,330 and 3,260 feet (Fig. 1). For cavern-development purposes, however, specific information was needed on the salt-bed characteristics immediately under the terminal site. It was obtained by running a gamma ray-Sonic Log in a hole which was ultimately completed as the salt-water-disposal well. The log showed salt between 2,330 and 3,350 feet. It also showed a 16-ft.-thick anhydrite and shale stringer between 2,336-82 ft. Three more lay between 2,382 and 2,826 ft. Below 2,826 ft., these stringers became more numerous.



WELLHEAD CONNECTIONS for one of the underground storage caverns used by the pipeline in the McPherson area.

Development wells. Information developed from the log showed that two 75,000-bbl. caverns could be created between 2,410 ft. and 2,826 ft. Hydraulic studies showed that the wells should be equipped with a 13⅜-in. casing and an 8⅝-in. tubing to deliver 1.500 g.p.m. with least horsepower requirements.

Two development wells were constructed with an 18-in. surface casing set at approximately 300 ft. and a 13⅜-in. casing set and cemented at 2,410 ft. The wells were completed for washing with 8⅝-in. tubing hung to 2,466 ft. and 5½-in. tubing hung to 2.810 ft.

A 125-bbl. reservoir was washed out by circulating down the 13⅜-8⅝-in. annulus and out the 8⅝-5½-in. annulus. This reservoir was then filled with propane to protect the casing seat and the roof of the cavern. Development washing was resumed.

The two wells were to be washed simultaneously, but there was an immediate need for storage. Consequently, an all-out effort to create capacity was necessary, and initial operations were confined to the well. This well is being washed at the rate of 310 g.p.m. and capacity is developing at the rate of approximately 1,500 bbl. per day.

Water source. Water for washing is

ALLIS-CHALMERS

This maintenance man's toolbox sums up the story of

the simplest process in petroleum:

maintaining the products of Allis-Chalmers
Even the standard products Allis-Chalmers builds for petroleum — for production, pipelining and refining — are designed for the industry's special requirements . . . and designed so routine inspection and maintenance are simply, quickly done.

And from no other manufacturer can you match the range of equipment available and benefit from Allis-Chalmers unit responsibility. Listed at right are some of the Allis-Chalmers products built to serve you economically throughout the plant—from crude to finished product.

For service that matches the quality of the equipment, call the A-C representative near you. Or write ***Allis-Chalmers,*** *Milwaukee 1, Wisconsin.*

"Teamed" Equipment from A-C . . . Electrical Generation and Distribution Equipment. Centrifugal and Rotary Vacuum Pumps, Motors, Motor-Generators, Motor Control, Blowers, Compressors, Water Conditioning, Earth Moving and Material Handling Equipment. A-1276

being supplied from a 16-in. water well completed at 240 ft. This well will be used later for product displacement. Since the well pump cannot provide enough head to wash the caverns, additional pressure is supplied by a two-stage centrifugal booster pump installed on the line to the caverns.

The brine is discharged into a pond where any shale and anhydrite washed from the cavern settles out. The brine is then injected into a disposal well completed with some difficulty in the Glorietta formation between 6,880 and 7,020 ft. Since this well would only take 200 g.p.m. on a vacuum, a two-stage centrifugal pump has been installed to inject brine at 310 g.p.m. under 200-psi. pressure.

Physical features of the beds underlying the sites were not known at the time the disposal well started. Successive formations were tested from 1,760 to 7,030 ft. before a suitable disposal formation was found. This well took some 53 days to complete. The cavern wells, on the other hand, took approximately 16 days each.

Initial capacity. These caverns will be washed to an initial capacity of 75,000 bbl. Then, the 5½-in. tubing will be pulled, a sonic survey run to determine shape and the 8⅝-in. tubing will be extended to the bottom of the cavern. The caverns will begin operation with fresh water used to displace product as necessary. Brine water produced during product injection will be wasted in the disposal well.

At the McPherson terminal, more specific information was available on formations underlying the terminal site. It was known that the Wellington salt should lie approximately 435-675 ft., that a disposal well could be completed in the Arbuckle formation, at approximately 4,000 ft., and that no water was available on site (Fig. 2).

Since the disposal well would require the most time to complete and specific information was needed on the salt under the site, that well was started first. As soon as it drilled through the salt section, a gamma ray-Sonic Log was run to obtain information on the salt. The well was then drilled to 4,290 ft., some 278 ft. into the Arbuckle formation. After acidizing, the well was tested at 18 bbl. per minute at 26 in. of vacuum. Elapsed time on this well was 30 days.

Three caverns. The gamma ray-Sonic Logs showed salt between 480 and 764 ft. The best salt section occurred between 605-710 ft. Since the section was relatively thin, three caverns of 50,000 bbl. each would provide the best installation.

A second rig was moved in to drill the three cavern wells. These wells were cased with 18-in. set at 160 ft. and 13⅜-in. cemented to 605 ft. They were completed with 8⅝-in. tubing hung to approximately 615 ft. and 5½-in. hung to 700 ft. Each took approximately 7 days to complete. The disposal well and the cavern wells were completed in a total time of 34 days.

Washing was started with water supplied by pipeline from a well completed in the Equus beds, some 4 miles east of the terminal. A 75-bbl. reservoir was washed at the top of the salt section being developed. It was filled with propane to provide a protective cap. Washing was then resumed with water circulated down the 5½-in. tubing and out the 8⅝-in.-5½-in. annulus. The three caverns were washed simultaneously at the rate of 180 gal. each and developed at an average rate of 505 bbl. per cavern per day.

Product removal. Due to a need for storage, washing was suspended at 27,000-bbl. capacity in each well. The 5½-in. tubing was then pulled, a sonic survey run and the 8⅝-in. tubing lowered to bottom of cavern.

Product removal will be by freshwater displacement until the caverns reach a capacity of approximately 75,000 bbl. A salt-water-displacement system will then be set up.

The salt section was relatively clean and little sediment was carried from the caverns. Consequently, the effluent was discharged into two 5 x 7 x 30-ft. portable mud tanks in series. The flow from these tanks was controlled by a float valve to keep a submerged suction and thus maintain the vacuum on the disposal well at all times.

Results indicate that the measures used to develop caverns at the two locations have been very effective.

6. Power service is carefully planned

Half-duplex d.c. channels are used to operate pulse-code transmitters.

OPERATION of a pipeline system today must have planning of power service. Specifications of motors, controls, supervisory equipment, etc., dictate the type most adaptable to efficient operation.

The Mid-America system has a total of 19,125 hp. of electric-motor capacity. This consists of 16,700 hp. in main-line drivers, 1,425 hp. in storage terminals, and 1,000 hp. at distribution terminals. Of the total, 17,350 hp. is operated at 2,300 volts and 1,775 hp. at 440 volts, or less.

Motors. All main-line pump drivers and storage-terminal injection-pump motors are 2,300-volt, horizontal, squirrel-cage induction motors with 60° C. rise, Class B insulation with 15% service factor, and NEMA 1 weatherproof enclosures. They range from 350 to 1,000 hp. All main-line pump motors were built on one of two frame sizes. Units of 600 to 1,000 hp. were built on one size frame, and units below 600 hp. on the other. This provides maximum interchangeability of pump units, reduces to a minimum the stock of motor spare parts, and improves maintenance efficiency. Main-line motors are equipped as follows:

1. Filters and stainless-steel screens.
2. All ventilation openings located above the shaft.
3. Mica-impregnated thermosetting plastic insulation.
4. Bearing and winding-temperature detectors.
5. Sleeve bearings.
6. Explosionproof terminal boxes.
7. Nonsparking rotors.
8. Corrosion-resistant internal coatings.
9. Space heaters.

All distribution-terminal loading pumps and storage-terminal booster pumps are equipped with 440-volt, 3-phase, vertical, explosionproof motors. All other pump motors are 440-volt, horizontal, with NEMA I weatherproof enclosures, and are installed in nonhazardous locations.

Switchgear

High-voltage switchgear is installed indoors in metal-clad enclosures. The switchgear assembly at each main-line booster pump station consists of two air-circuit-breaker-type motor-starter

cubicles, and three auxiliary cubicles for incoming terminations, transformer, batteries and chargers, and auxiliary switchgear equipment. At the originating stations, and at stations adjacent to delivery terminals, a disconnect for a yard-mounted transformer is included in the switchgear lineup.

The switchgear is equipped with lightning arrestors, surge capacitors, and insulated bus. At some locations, each motor starter is equipped with a power-factor correction capacitor. The capacitors are switched with the motors to prevent overcorrection and leading power factor.

Main breakers are not used in the switchgear. Primary disconnect is obtained by means of a three-pole, gang-operated, pole-top-mounted disconnect switch installed at the substation.

Unattended points. At all unattended stations, the switchgear is equipped with ground indicators on the 2,300-volt a.c. and 48-volt d.c. systems. At all attended locations, a ground indicator is also provided on the 480-volt system.

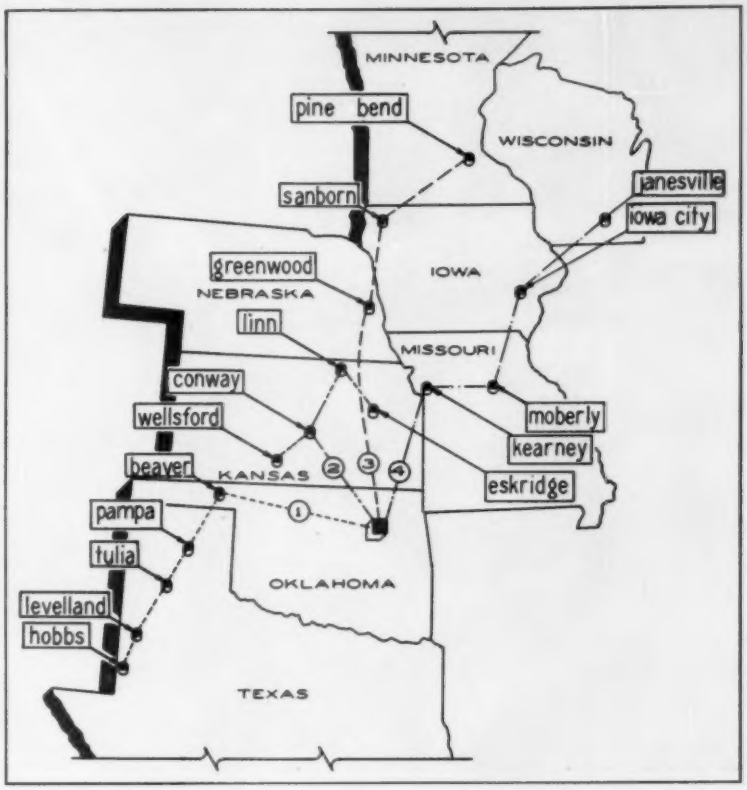
Each motor starter is equipped with individual circuit breakers. All power to a unit can be disconnected for maintenance purposes without affecting normal station operation.

Low voltage power for auxiliary pumps, electric valve operators, lighting, and heating is distributed through motor-control centers.

A master control panel at storage terminals has a graphic display of local yard piping, storage tanks, and pumps. Control and recording instruments are located on the panel and all electrical operations at the terminal can be controlled from it, including local control of the main-line pump station.

Underground wiring is installed in rigid steel conduit with high-voltage runs encased in concrete. High-voltage cable is nonshielded, with extra-heavy insulation. Control cable is used for valve operators and tank gage wiring, and 90° C. TW wire for all other underground power and control wiring.

All pumping and booster stations except the Janesville, Pine Bend, and Moberly terminals have a minimum voltage of shielded 34.5-kv. Delta for primary service. It is preferably ring-looped for stability and backup power to eliminate outages. Five stations are served with 69-kv. and eight with 34.5-kv. voltage.



PUMP STATION LOCATIONS and indication of four channels for supervisory control from Tulsa.

Since across-the-line starters are used it was imperative that voltage stability be maintained without drop and the drop in voltage on motor start be no more than 15 to 18%. If the expected drop exceeded 20%, the power company provided capacitors and/or voltage regulators as the condition dictated. Oversizing of transformers overcome the drawdown voltage condition on motor start in several cases.

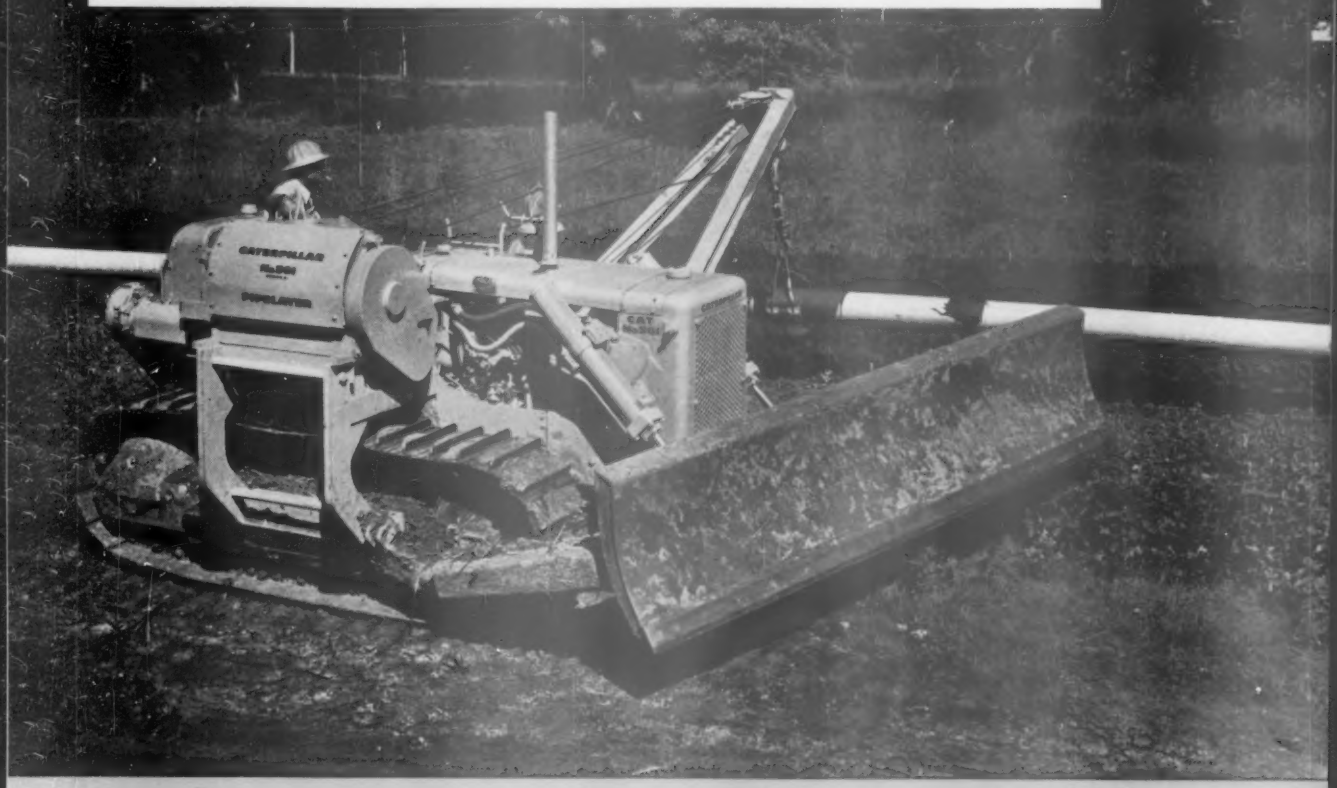
Second stage. Secondary operating voltage is 2,400 volts, 60 cycles. At the booster stations where there is no product loading, the transformation of 2,400 volts to lower voltages for heating, lighting, gate operators and supervisory equipment is done by a transformer in the equipment cubicle. At the station terminals, with loading and storage operations, an outside substation 2,400 to 480 volts is provided adjacent to the power-company substation. This substation is rated to the terminal operating-load demand.

All metering is on the load side or 2,400-volt side of the substation. The substation is on the load side or 2,400-volt side of the substation. The substation layout at all stations includes a primary fused disconnect, utility-company transformer bank, company metering, company hook or gang-operated disconnects, and a company-provided connector point to which Mid-America attaches its 2,400-volt service conductors. The disconnect on the load side of the substation is used when it becomes necessary to clear the station for repair purposes or in case of emergency, fire, etc.

Underground conduits and conductors between the substation and motor control building are designed for ultimate load expectancy. All grounding is common with the power company serving the station. The substation and

"Main breakers are not used in the switchgear. Primary disconnect is obtained by means of a three-pole, gang-operated, pole-top-mounted disconnect switch installed at the substation."

Cat 561 Series B shown here without counterweights at work in Texas handling 10″ pipe. For lifts up to 38,800 lb., three counterweight arrangements (fixed and hydraulically adjustable) are available. D333 Engine delivers 93 flywheel HP with high torque at low speed. Has Cat Oil Clutch, lifetime lubricated rollers.



MD7 AND 561 PIPELAYERS ...Caterpillar makes 'em

TAKE THE CAT 561 PIPELAYER—G. W. Townsend Lease Service (Bay City, Texas) used a 561 to lay four miles of 10″ and 12″ natural gas line for Pan American Petroleum Corp. near Sweeny, Texas. In open country, 600′ of pipe was lowered into a 48″ by 24″ ditch in two hours. In close quarters, an average of 2000′ of pipe was lowered in daily.

What do the Townsend people think of the 561? They like the way it handles. They like its balance and the way it responds—fast and accurately. The operator singled out the placement of controls. They're in easy reach, without stretching. Their location permitted him to keep his eyes on the work as he moved along the ditch.

With an angle filler up front, Townsend's 561 takes on extra jobs—backfilling and other utility work. (Another contractor put a No. 6A blade on his 561, uses it for right-of-way clearing. The 561's integral hydraulic system—optional—makes it easy to handle a blade, keeps pump and valves under the hood out of the way.)

All in all, the 561 does the kind of job you expect of Cat Pipelayers. *Dependable*—work done quickly and economically.

OR TAKE THE MD7—Ford, Bacon & Davis Construction Corp., Monroe, La., had about 30 miles of 12″ pipe to lay south of Welsh, La., for

Cat MD7 is shown cradling pipe in Louisiana marshland. The Series D MD7 has greater power (140 flywheel HP and 54,200 lb. lifting capacity), improved torque rise (boosts lugging ability by 80%), and there's a new dry-type air cleaner, new, stronger final drives, and many other advantages to boost production and lower costs.

to make money for you

the Louisiana Pipeline Company. The route met an average of three irrigation canals per mile, in addition to Louisiana bayous and swamps. Even so, with three new Cat MD7 Pipelayers in the spread, 4000′ to 5000′ were laid every day.

The MD7's seven-roller track frame and 22″ track shoes give the new Cat Pipelayer exceptional stability and flotation needed in swamps and bayous. No wonder, then, that Ford, Bacon & Davis are pleased with the performance of the new MD7s. They bought them for high production under tough conditions. And that's what they're getting.

These new Cat Pipelayers have what it takes to turn in performance records even better than previous models. Extra production slashes operating and maintenance costs . . . see your Caterpillar Dealer for the whole story on the new pipelayers. Ask for an on-the-job demonstration.

Caterpillar Tractor Co., General Offices, Peoria, Illinois, U.S.A.

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The Mid America Pipe Line Company and Williams Brothers chose Seamless #657 High Density Polyethylene Tape for coating the complete gathering system and a portion of the main line on the Mid America Pipe Line Company's L P G system.

The Seamless Rubber Company is proud to have been a major supplier on this new pipe line installation.

Whether for main-line construction or an accessory application, Seamless has a specific tape for your installation. Write for field specifications and particulars.

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enclosure is provided by the power company on Mid-America station property.

At the end terminals, Janesville and Pine Bend, and intermediate terminal at Moberly, Mo., where no booster pump station exists, primary voltage service of 7.9/12.5 kv. to 480 volts is supplied. Secondary metering is also provided here.

Communications

Because of the operating characteristics of the supervisory-control equipment, it was decided to use half-duplex d.c. channels to operate the pulse code transmission of the centralized traffic control functions.

1. Half-duplex communication sections provide for transmission in either direction, but only in one direction at a time.
2. Terminal equipment at intermediate stations is operated back to back. The channel terminals have their d.c. loops directly interconnected to each other.
3. Dropoff loops in circuits operate on a split full-duplex basis to provide for insertion of supervisory equipment at intermediate stations.

Can expand. Fig. 1 indicates the grouping of the stations by circuits. Grouping the stations allows future intermediate booster stations to be added by splitting circuit 1 and creating a fifth circuit. The other circuits in the supervisory channel network would remain as shown unless it becomes necessary to add more than two stations to each of the circuits 2, 3, and 4.

At Hobbs, Conway, and Eskridge stations and the Sanborn and Pine Bend terminals the telephone company has terminating equipment in the station terminal building. At other stations, local loops originate in telephone-company exchange facilities nearest to the stations involved.

All station terminals with the exception of booster stations 2, 3, 4, 5, and 6, have FB-1 private business phone service. Hobbs station has foreign-exchange service to Hobbs, N. M., and Conway station has foreign-exchange service to McPherson, Kans.

In addition to the supervisory circuits, a full-period teletype network connects the Tulsa dispatching office to all district offices, storage terminals, and product-delivery terminals.

Written form. The system meets requirements for fast written communications and transmits all orders and messages that can be handled in written form. Sixty speed, Model 28, KSR

Check this DARLING gate valve trio for

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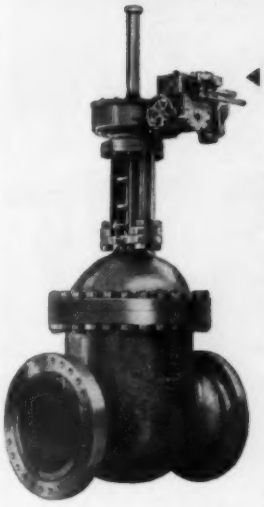
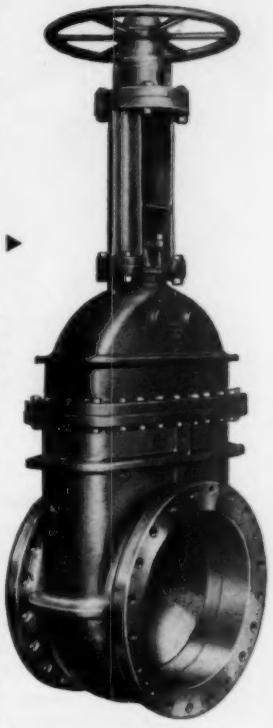
in every oil, gas and petrochemical service



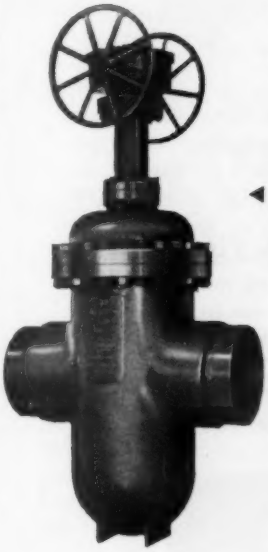
◀ DARLING FULLY REVOLVING DOUBLE DISC GATE VALVES

—famous for *consistently* trouble-free operation in all kinds of service. Revolving disc principle assures easy operation, surer closure, minimum friction, automatic seating compensation, extreme life with minimum maintenance. Ask for Catalog 57.



DARLING ALUMINUM ALLOY GATE VALVES ▶

—featuring all the advantages of the above revolving disc principle, *plus* new economies in the handling of "problem" fluids and gases or wherever aluminum piping is used. Ask for Bulletin SLS 5801.



◀ DARLING-McEVOY SELF-SEALING CONDUIT VALVES

— the *only* conduit gate valve with *sealant gasketing* between gates and seats. Every closure leakproof! This and other advantages proved by outstanding performance on major lines. Get *all* the facts. Ask for Catalog 57.

Whatever the service, in any phase of pipelining, gathering or processing, these Darling gate valves offer worthwhile features and advantages unobtainable in other valves. The catalogs referred to above are available to give you the pertinent facts.

DARLING VALVES

DARLING VALVE & MANUFACTURING CO.

Williamsport 1, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario

Congrats and $25 for this quip to M. H. Barber, Continental Oil Co., Big Spring, Texas.

"told him to pack the pump"

Whether it's running casing for surface hole, intermediate string, oil string or tubing . . . Lone Star Steel pipe is the brand Joe Roughneck counts on. Centrally located in the heart of the Mid-Continent oil producing area, Lone Star delivers API electric-weld casing, tubing and line-pipe on the double . . . in quantity! And, you can depend on Lone Star for quality as well as quantity. Our ultra-modern steel mill is equipped with the newest, most efficient tools in the industry. Rigid quality control is maintained from ore to finished product.

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MID-AMERICA PIPELINE

machines with stunt-box selective signaling serve all points on the network. A Model 28-ASR machine equipped with a typing reperforator (35C901) is in the Tulsa dispatcher's office. Single-copy page printing is used except where duplicate message copy is required.

Vibratory-horn signaling, relay controlled, is in service at each point, energized by the local telephone signal ring, the teletype-writer signal or local power failure. All machines have type-C keyboard arrangement. Each point has an individual code signal. All points are on a master code, on and off, and codes for each of three groups.

Each loading terminal has a pay telephone for transport drivers.

All leased communication facilities enter station or terminal properties at a designated point. An underground duct takes them to the terminal office building and thence, underground, to the control building where centralized traffic control equipment is located. Supervisory circuits terminate directly in the centralized traffic control panels at booster stations.

Nine connecting, independent telephone companies are involved on the entire communications system. The backbone circuit is furnished by AT&T Co. Long Lines department, Southwestern Bell Telephone Co. and Associated Bell companies.

Mid-America has a VHF-UHF base-to-mobile two-way radio-communications system. It covers the Permian basin area of Texas and New Mexico and extends along the main-line system from Hobbs station to Conway station in Kansas.

The gathering system centers in the control-base station at Hobbs station east of Hobbs, N. M. Through relay frequencies it controls Maljamar base east of Artesia, N. M., and Fullerton base, southeast of Eunice, N. M. Through a repeater base station at Patricia, Tex., is also controls VHF transmission at Coahoma-Sand Springs east of Big Spring, Tex., and Midland base station, southeast of Midland, Tex. All points mentioned except Hobbs are unattended.

The relay frequencies of the gathering system are in the 72-76-mc. increment with the exception of the repeat relay frequency in the 451-456 increment. The latter controls the repeat leg between Patricia relay base and Coahoma-Sand Springs base station near Big Spring. Higher frequency was necessitated by possible interference of Channel 4 TV at Big Spring.

Mobile units. Mobile units are fully transistorized and transmit on the as-

signed frequency of 49:36 mc. at 100-watts output. Base stations transmit at 330-watts power at Hobbs and 100 watts at other gathering system base stations. The mobile unit in the unattended base-station system is the control for field transmission back to central control-base station at Hobbs station. One control frequency is used at Hobbs control base which has tone superposed to select five remote-base stations—four in the gathering system and one on the main line.

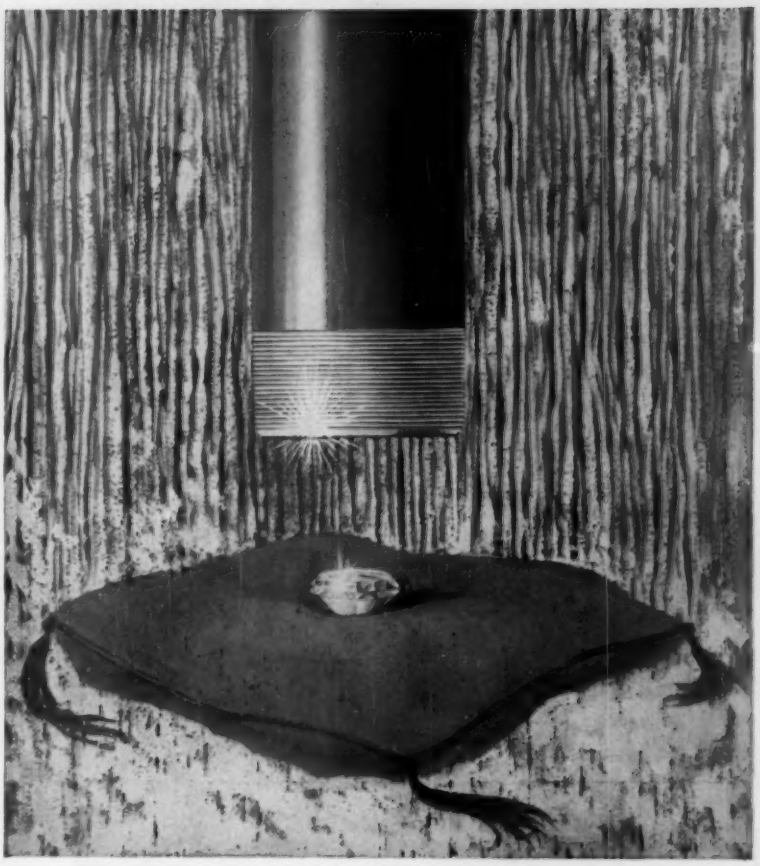
Special efforts were made to secure ample antenna height, correct antenna design, and the best tower locations in respect to the surrounding country so that the signal from base-station transmitters would be sufficient in insure contact to and from mobile units in all areas in which they operate. Antennas were placed from 330 to 409 ft. above the ground level. Hobbs station, Patricia relay repeater station and Conway station have equipment houses. All guy points and tower base areas are fenced for protection from livestock, etc. All company-owned radio towers are 340 ft., steel utility type with A-3 lighting as specified by the FCC and FAA.

Relay control. Hobbs relay control operates the unattended Levelland base station 100-watt transmitter. Directional antenna, doubled, obtains optimum base-to-mobile coverage toward the next unattended station at Pampa, Tex., which has a 100-watt transmitter. Pampa base-station's antenna is doubled and directionalized so that maximum signal strength is transmitted up and down the pipeline.

The Liberal, Kans., district-office relay control-base station transmits to Waka, Tex., repeater to Pampa unattended on 451-456 mc. increment of frequencies, to eliminate any possibility of interference with TV channels 4 and 5 at Amarillo and Lubbock, Tex. No intermediate VHF contact-to-mobile unit is required at Waka relay point since the distance between Liberal, Kans., VHF base station and Pampa, Tex., is 102 miles. Transmitter output at Liberal is 330 watts. Ample coverage because of flatness of terrain between Pampa and Liberal insures base-to-mobile contact from either station. Directional antennas, doubled, are used at all low-band transmitter points on the main-line system.

Leased space. Antenna cable and equipment housing space is leased at Midland, Tex., Levelland, Tex., and Liberal, Kans.

Conway station is the terminus of the base station network in the radio system as it is now equipped. The 340-ft. tower, equipment house, directional



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OIL AND GAS
INDUSTRY

The jeweler, in showing a fine stone, often displays it on a velvet cushion so that its true brilliance and beauty of cut will be most apparent to the viewer.

We, of Lone Star Steel Company, feel a similar pride in bringing to your attention the quality and precise craftsmanship of Lone Star API casing, tubing and line pipe.

Further, Lone Star Steel craftsmen take a comparable pride in Lone Star pipe because it represents the personal care which has become the hallmark of their skill.

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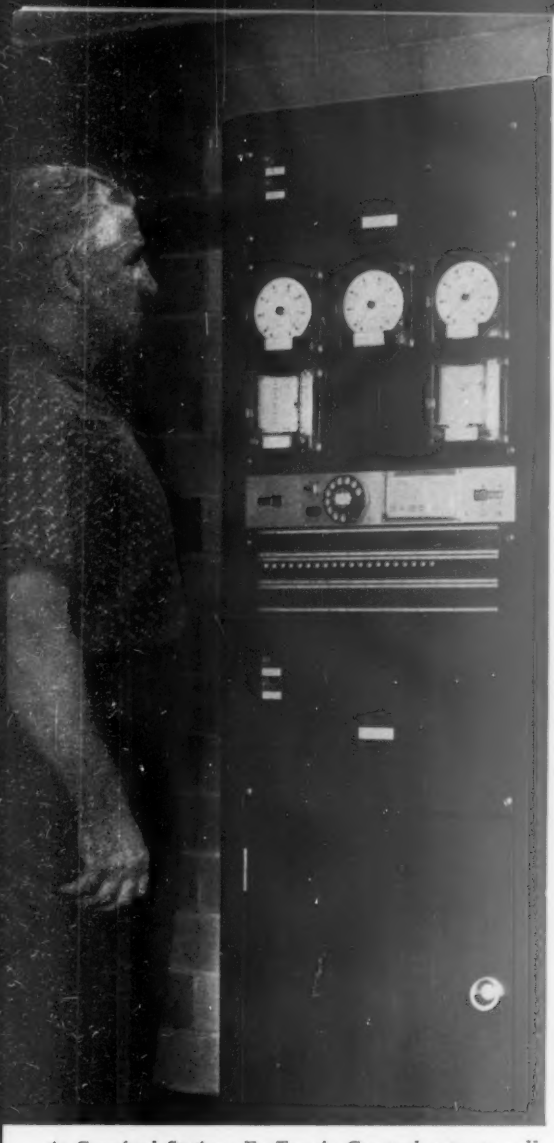
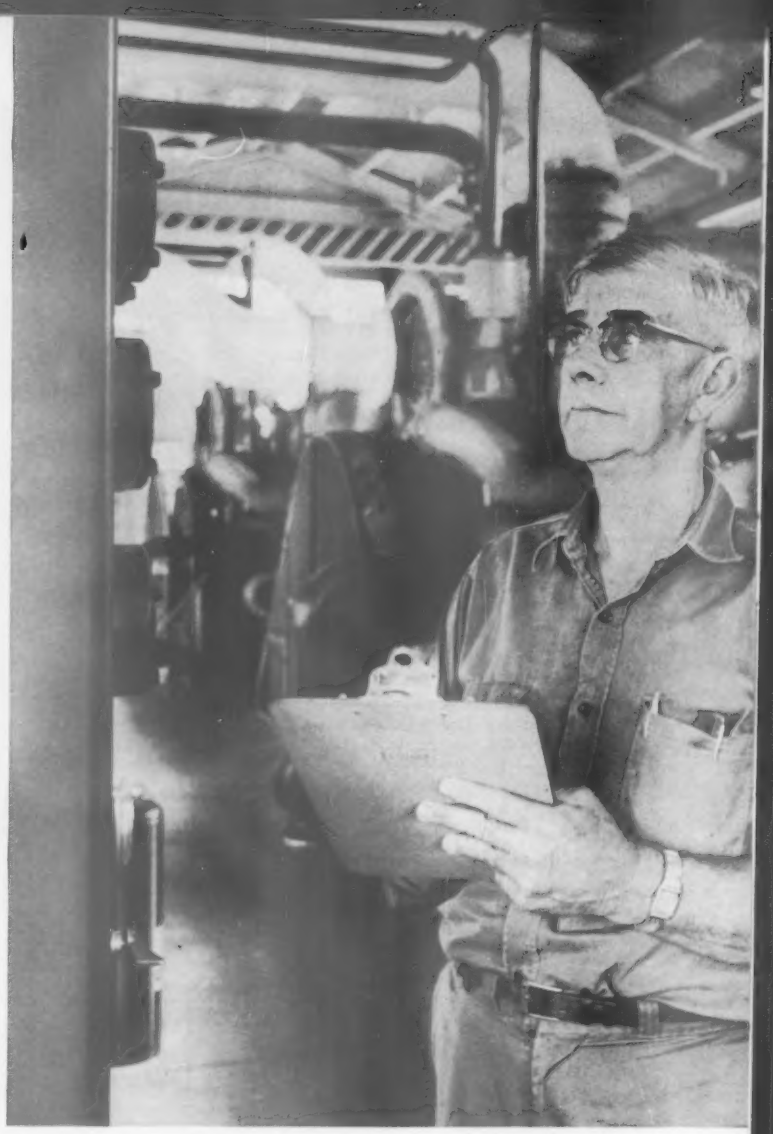


At Crawford Station: En-Tronic Control actuates all functions at McArthur Station and records engine speeds and pressures. Shown here: W. E. Deeds, Engineer in Charge.



At McArthur Station: James Caldwell, Chief Engineer takes a reading from the En-Tronic Control of one of the Cooper-Bessemer compressors. This control actuates starting sequences and monitors the complete operation.

How Cooper-Bessemer equipped McArthur

TO START OR STOP McArthur Station's 1100 hp Cooper-Bessemer compressors, they simply dial a number. This storage field station of Ohio Fuel Gas Company is fully automatic, day and night... controlled from their Crawford Station 34 miles away by Cooper-Bessemer En-Tronic Controls. They start and stop the three GMVA Compressors... record engine rpm, discharge and suction pressures, and gas

At McArthur: This En-Tronic Control is a telemetering and supervisory control unit for the entire operation. Compressors can be started or stopped from this location as well as from Crawford.

Station operates automatically round the clock

flow... and operate the 20″ main valves from the remote station.

Now completing two years of operation, McArthur Station has an impressive record of dependability.

It will pay you to investigate Cooper-Bessemer reciprocating compressors, centrifugal compressors, engines and En-Tronic Controls for *your* expansion and modernization plans. Call our nearest office.

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ENGINE, TURBINE OR MOTOR DRIVEN

antenna, doubled for increased coverage down the line, is located on the station property and is remotely controlled from the station office building.

Liberal district office remotely controls the VHF base transmitter and the 451-456 mc. relay transmitter. Hobbs station base transmitter and relay transmitters are remotely controlled from the station office.

North of Conway, because terminals are continuously manned, mobile radio-equipped cars are used for car-to-car contact only.

Base stations may be added to the network to cover the entire system more completely and efficiently.

7. Designing and building the main line

Main line is tested effectively in 100-mile sections as result of daily cleaning.

THE MAIN LINE of the Mid-America pipeline system was divided into six sections to facilitate control of the construction spreads and to provide a logical pattern for the purchase and delivery of materials. Total length of the main line is 1,685 miles. Sections 1 and 2 go from Hobbs, N. M., to Conway, Kans.; Sections 3 and 4, north from Conway to Pine Bend, Minn., and Sections 5 and 6, east from Conway to Janesville, Wis. The main line was designed in strict conformance with ASTM American Standard Code for Pressure Piping, ASA B31, 4-1959, Oil Transportation Piping.

The main line required 289 miles of 10.750-in.-o.d. by 0.250-in.-wall-thickness API 5LX-X52 line pipe, 1,240 miles of 8.625-in.-o.d. by 0.219-in.-wall-thickness API 5LX-X52 line pipe, and 154 miles of 6.625-in.-o.d. by 0.188-in.-wall-thickness API 5LX-X46 line pipe. Under the above-mentioned code, allowable working pressures at 72% of the minimum yield strength are 1,741, 1,901, and 1,880 psi., respectively for 10, 8, and 6-in. pipe.

Working pressure. Actual working pressure for all sections was dictated by the decision to use standard ASA 600-lb. flanged and welded fittings throughout the system. Allowable working pressures, therefore, were established at 1,440 psi., and this accordingly was the design discharge pressure for all pumps and control equipment. A special O-ring-type gasket was used for all flanged connections. This gasket will allow a somewhat higher working pressure. In view of the allowable working pressures of the line pipe, it is probable that in the future the line pressure will be increased for additional throughput.

Valves are aboveground between pump stations at intervals of approximately 25 miles. These are weld-end, through-conduit gate valves especially suited for propane service. Reinforced hubs are on all weld-end valves and flanges attached to the high-yield-strength main-line pipe.

Unique blowdown devices are used on both sides of each valve installation. These consist of a 2-in. nipple threaded to receive a plug, in which a ball check valve is installed. When pressure observations only are required, a simple adapter is attached to the cap on the 2-in. nipple. A rod in the adapter pushes the ball check off its seat, thereby providing a sufficient opening for obtaining accurate pressure readings. When the full area is required for actual purging operations, a tapping machine removes the plug through the body of a screwed 2-in., full-opening gate valve.

Crossings

There are approximately 150 river and stream crossings. For the purpose of design, these rivers were classified as either major rivers or small rivers and streams. Criteria for classification included investigations into both the normal stream characteristics and those met during flood conditions. Major rivers required heavy-wall API 5L Grade B pipe, and concrete bolt-on-type river weights.

The wall thickness for the 10, 8, and 6-in. heavy wall pipe was 0.500, 0.438, and 0.280 in. respectively. Cover requirements varied with each river, but 8 ft. was generally required. A double thickness of coating and wrapping material plus wooden slats protected the pipe during the laying operations and furnished adequate protection against corrosion. The only departure from this procedure for the small rivers and streams was the substitution of standard line pipe for the heavy wall pipe.

All river crossings were buried with one exception. This was the crossing at the Burt County bridge over the Missouri at Decatur, Neb. The approach was from the south while the pipe actually was suspended on the north side of the structure. This was an ideal arrangement and provision was easily made for movement of the pipe due to temperature variations.

No loops needed. No additional expansion loops were required on the bridge and the pipe was anchored before passing under the bridge. The exposed approach and exit lengths supplied sufficient flexibility for expansion and contraction. The bridge alignment was almost perfectly straight and eliminated the need for anchor devices attached to the bridge. Either rollers or hanger rods were provided from one end of the bridge to the other.

There are insulating gaskets on both sides of every major river crossing and the one overhead crossing. Installation of these gaskets was easily made on the flanged face of the full-opening gate valve upstream from each crossing and the flanged full-opening check valve downstream. These valves will facilitate the construction of a new line across the channel in the event of failure. All crossings are single line only.

Approximately 51,000 ft. of casing was required for crossing under highways, hard-surfaced roads, railroads, and telephone cables. The wall thickness of casing pipe for all sizes was 0.250 in. The requirements outlined in the API "Recommendations for Cased Crossings" and the American Railway Engineering Association "Specifications for Pipeline Crossings Under Railway Tracks" were followed with few exceptions.

"All river crossings were buried with one exception. This was the crossing at the Burt County bridge over the Missouri at Decatur, Neb. The approach was from the south while the pipe actually was suspended on the north side of the structure."

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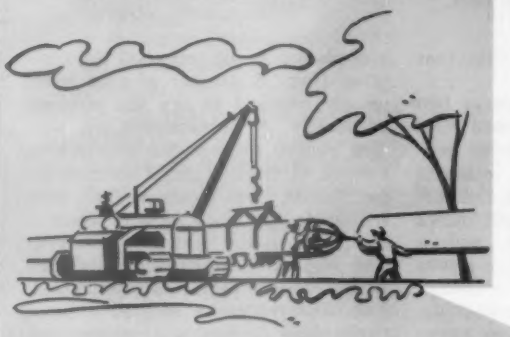

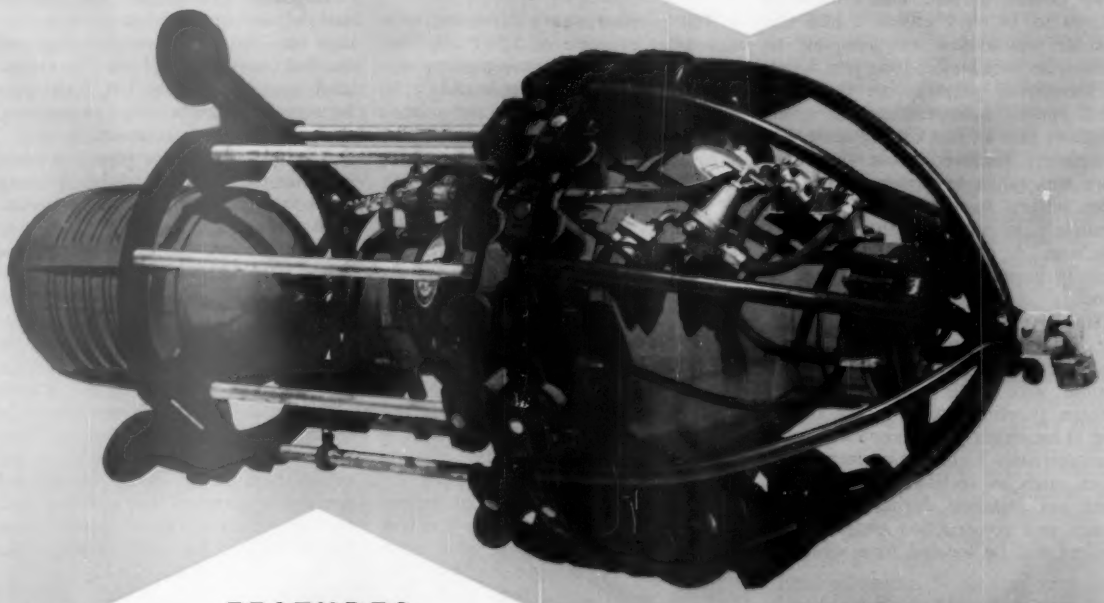

FEATURES:

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- lighter weight
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CROSE-PERRAULT LINE-UP CLAMPS HAVE LINED UP MORE MILES OF PIPE THAN ALL OTHERS COMBINED.

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Double vents. Double vents were placed on the casing for all crossings of 60 ft. and over; under 60 ft. a single vent was installed. Plastic insulators were used with excellent results. Breakage of these insulators was practically nil. Centering cradles were not used but a plastic insulator was placed 6 in. from each end of the casing. This arrangement means that the carrier pipe was not centered in the casing pipe, but no difficulty was experienced in installing flexible-type casing seals. Each cased crossing was checked with a welding machine for complete insulation prior to backfilling.

Hot - applied coal - tar enamel was used for coating all pipe north of the Levelland pump station. The only variance from standard coating procedures was the use of a glass outerwrap instead of felt. This outerwrap proved to be very effective and the coal-tar penetration was adequate to furnish an excellent coating job. South of Levelland, polyethylene tape was used. Special consideration was given to insure that all rust or mill scale was completely removed from the pipe. Care was taken to prevent loose dirt from settling back onto the pipe immediately in front of the wrapping machine. A good cleaning was extremely important to obtain adequate bond.

Single - wire cathodic test stations are installed at intervals of approximately 3 miles. Additional single and double wire leads were placed for foreign pipeline crossings, at rivers, and at locations with known corrosive characteristics. Cathodic-protection devices, such as rectifiers and anodes, were not installed during the initial design and construction phase. These devices will be located from observations obtained during the first year of operation.

"Hot-applied coal-tar enamel was used for coating all pipe north of the Levelland pump station. The only variance from standard coating procedures was the use of a glass outer wrap instead of felt."

Aerial markers were made of two 16 by 36-in. porcelain-finished steel plates. The markers are placed generally at intervals of 1 mile, in fences or along roads and railroad right-of-ways. Pipeline markers made of 12 by 12-in. aluminum plates, with a baked-on enamel finish, were placed at all major roads and rail crossings. This marker tells how to contact the company in the event of an emergency.

Testing

The pipeline was water-tested to a minimum pressure of 1,584 psi. The test was completed between pump stations on sections approximately 100 miles in length. This long test section was made possible by daily cleaning of the pipeline as construction progressed. This cleaning was accomplished with at least two runs of an air-driven, scraper - type, pipeline cleaning pig, and was extremely effective.

When the testing crew started operations there was very little mill scale or debris in the pipeline. A simple proportioning device was used on the fill pump to inject a solution of rust inhibitor into the water used for testing. This water was blown from the line after testing, but a protective film remained to prevent further rusting.

Filling the line with propane required careful planning. Just before the filling operations, the pipeline was cleared of all water and solids with a displacement pig propelled by compressed air. A number of runs were usually required to dry the pipeline adequately. A displacement pig was then pushed through the line with a column of natural gas. This natural-gas "buffer" was extended from one station to the back-pressure control equipment at the next pump station. The propane was then injected at sufficient pressure to displace the natural gas. This procedure assured a relatively clean product and reduced the danger from fire hazards.

Logistics. The proper procurement and delivery of materials for construction required extensive planning and the full cooperation of all. The scheduled completion date left little time between the completion of engineering design and actual construction.

Supply locations for pipe and coating materials were established along the route at 25 to 30-mile intervals. These materials were scheduled to precede construction by 15 to 45 days. Seven steel mills supplied the pipe for the main line and considerable time was given to arranging rolling schedules and shipping dates to coincide with construction requirements. Single supply points were established in each construction section for miscellaneous materials such as valves, fittings, markers, casing fittings, etc. The time and effort spent on this complete material scheduling program was well justified. In no instance were construction forces delayed by lack of materials.

8. Tie-in lines use thin-wall pipe

Polyethylene wrap protects complex system connecting gasoline plants.

BECAUSE of the many, widely spaced gasoline plants in the New Mexico-West Texas area, the selection of the final pipeline route was difficult. Several layouts with several combinations of pipe sizes were required to make a carefully coordinated system. The system selected was the most economical from the investment and operating standpoint.

Reduced operating pressures are used in this area to keep the injection pressures at the gasoline plants as low as possible. This allowed thin-wall pipe to be used.

Size	Wall Thickness
8⅝-in. o.d.	0.188-in.
6⅝-in. o.d.	0.156-in.
4½-in. o.d.	0.142-in.

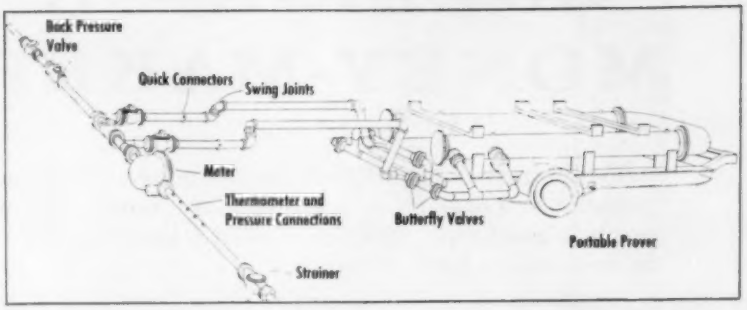
All pipe has a tensile strength of 42,000 psi. and was manufactured in accord with API 5LX standards.

Corrosion Protection

The gasoline plant lines are wrapped with polyethylene tape. Test leads were installed at approximately 2-mile intervals. Rectifiers and anodes will be used for cathodic protection after the backfill has had a chance to settle.

All gasoline plants are isolated from the pipeline system by insulating gaskets. Insulating gaskets were also placed in the trunk gathering lines to facilitate testing of the effectiveness of the cathodic protection.

An automatic unattended booster station, without remote control, is located near Midkiff. It consists of one 200-hp. electrically driven centrifugal pump. The unit is automaticlly started and stopped, as the hydraulics of the line require, by pressure switches.



PORTABLE PISTON-TYPE PROVER is easily connected, capable of 1,000-psi. working pressure. Fig. 1.

Custody Transfer

In order to receive product economically from the large number of plants, each plant has a meter installation to deliver to the pipeline. All are quite similar.

A strainer, pressure-temperature recorder, and back-pressure valve, in addition to the necessary valves, are used at each location. (Fig. 1.) The back-pressure valve is important since the product must be held under pressure to prevent it from vaporizing and causing inaccurate meter readings. The back-pressure valves are self-contained pilot-operated units and are located away from a commercial source of power.

A combination pressure-temperature recorder is used to make the necessary corrections for these variables. Temperature-corrected meters are not used since it would still be necessary to make pressure (compressibility) corrections.

Combination plug-check valves were used at the injection points to safeguard the plants from the high pressure in the line.

Provisions were made to deliver to and receive from shipper's underground storage facilities at several locations in the Hutchinson and McPherson, Kans., areas.

Metering installations at these locations are basically the same as at gasoline plants except for valves and piping to reverse the flow in the system without reversing it through the meter.

The lateral lines near Hutchinson and Conway delivering to shippers will be kept under reduced pressure while deliveries are being made. This is needed because the shippers will often inject directly to underground storage. Like any other pressure vessel, underground-storage caverns can be ruptured by excessive pressure. A self-contained pressure-reducing valve provides this safety feature.

DORCHESTER CORP.'S Cargray gasoline plant—one of the Mid-America shippers in the Pampa area. (Left to right) Paul Reed, Journal pipeline editor; Henry Branham, Williams Brothers superintendent, and B. O. Bentley, Dorchester plant superintendent.

Prover System

One of the most difficult and expensive requirements in metering LPG has been the proving system for high-vapor-pressure products. It was decided that the most satisfactory and most economical would be a portable piston-type prover. These provers work on the principal that a uniform quantity of fluid will be displaced in a section by piston or sphere pushed by the fluid. Switches on each end of the section start and stop an auxiliary counter automatically without stopping the flow of fluid through the meter or the prover. It is a closed system and thus is ideally suited for LPG products. It is also very rapid and is relatively free of the possibility of human errors. This technique is expected to be included in a revision of API 1101 Petroleum P. D. Meter Code.

It was decided that a sphere used in a U-tube would provide the necessary volume and length of prover and would be most satisfactory from the portability and accuracy standpoints. (See Fig. 1.)

The portable prover unit is 18½ ft. long and 6 ft. wide and weighs approximately 4,500 lb. It can be used at the normal operating pressure of the meters. It can be connected to the metering system using quick couplings and swing joints to provide a prover capable of 1,000-psi. working pressure where required.

SUPER-INCH MONEY-MAKER

Allis-Chalmers 225-hp HD-21 has the power, side boom capacity and over-all strength to make money for you on the biggest pipe—and the over-all design superiority to do it in any kind of terrain.

Pipeliners are using Allis-Chalmers HD-21 side boom crawlers to handle the biggest pipe loads; 34-in., 36-in., 42-in.—and heaviest of all—the concrete-coated pipe. And these big-capacity machines not only move right along with the super-inch stuff, but they also work profitably on medium-inch lines.

When you consider your next pipeline tractor spread, look at every factor—original cost, fuel consumption, ease of maintenance, life of components, over-all performance, nationwide dealer service—and you can look to Allis-Chalmers for your best tractor buy.

Note the rocky, abrasive ground in this picture. There's just one track that's made-to-order for this rough stuff—that's Allis-Chalmers. Special steels that are specially heat-treated make these track shoes, side bars, track pins and bushings the industry's toughest.

One last point. Pipeliners say nothing matches an Allis-Chalmers side boom tractor for flotation and maneuverability in muddy, swampy going. A tractor that's dependable in mud is good anywhere. Your Allis-Chalmers construction machinery dealer is eager to prove it with a demonstration. He is also in a position to give you the best possible terms. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

HD-21
Crawler Tractor

- *225 net engine hp*
- *Hydraulic torque converter drive*
- *Bare tractor weight: 46,200 lb (long track model)*
- *Weight with side boom: 79,050 lb*
- *Side boom lifting capacity: 127,000 lb at 4 ft*

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VETERANS OF THREE YEARS OF TOUGH PIPELINING. These HD-21's are three years old and still going strong. Owner reports, "These tractors have been steady, dependable performers under tough operating conditions."

COPAN STATION, Oklahoma, was site of pipeline-control tests. Control room is about 150 ft. from the pump. Fig. 1.

Recent tests throw new light on the question . . .

How good are pipeline control systems?

A series of tests performed by Sinclair Pipe Line Co. in cooperation with seven major instrument companies shows that much improvement is needed and outlines areas where most of the work should be done. The elaborate, detailed tests also enabled Sinclair to determine nine essential characteristics of a good pipeline control system.

About the author...

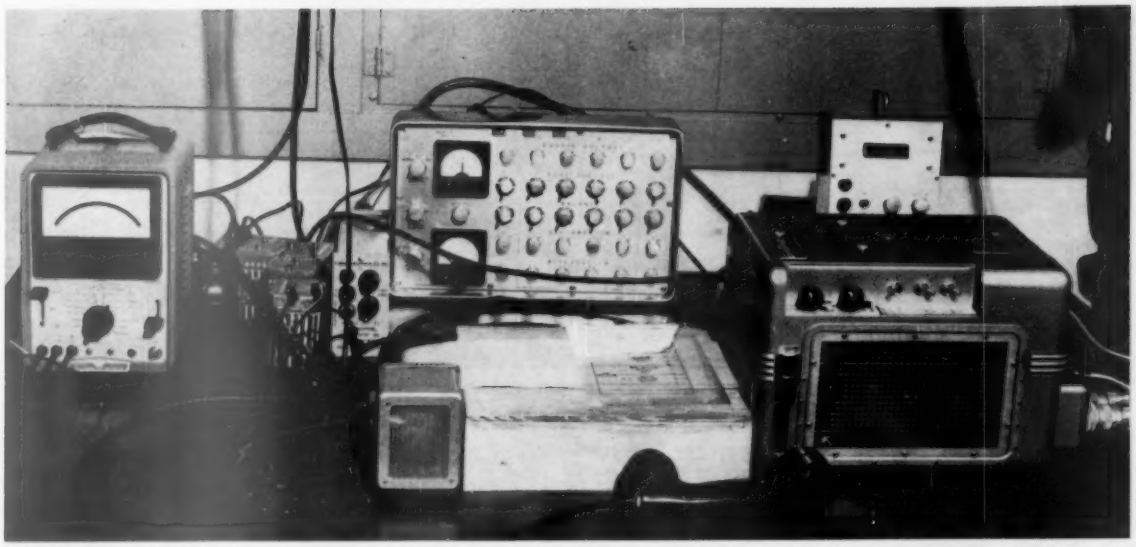
HENRY A. BRAINERD is senior engineer, research and development section, Sinclair Pipe Line Co. During the past year he has done special research on evaluation of control systems for pipeline use. Other Sinclair experience includes 4 years as senior engineer on various pipeline construction and operation projects, and 3 years at Sinclair Research Laboratories, Harvey, Ill., as research representative of the pipeline company. Prior to his Sinclair experience, Brainerd was controls-system and hydraulics engineer for Philadelphia Electric Co. He is a 1948 graduate of University of Delaware, with a BS in Mechanical Engineering. He is a registered engineer (Pennsylvania) and a member of ASME.

RECENTLY Sinclair Pipe Line Co. set about to determine just what is needed in a pipeline-control system and whether available control systems could meet these needs. After 6 months of intensive testing involving control systems of seven instrument companies, with the test of each system presided over by a representative of the manufacturer, it was found that only one system met the prescribed control standards.

Much was learned about pipeline control from each of the seven tests. Results from all of the tests led to the formulation of a list of nine characteristics which are essential for a good control system.

The Problem

The control system at a pipeline pump station is an unwanted necessity. This is because control is generally achieved by throttling, which wastes



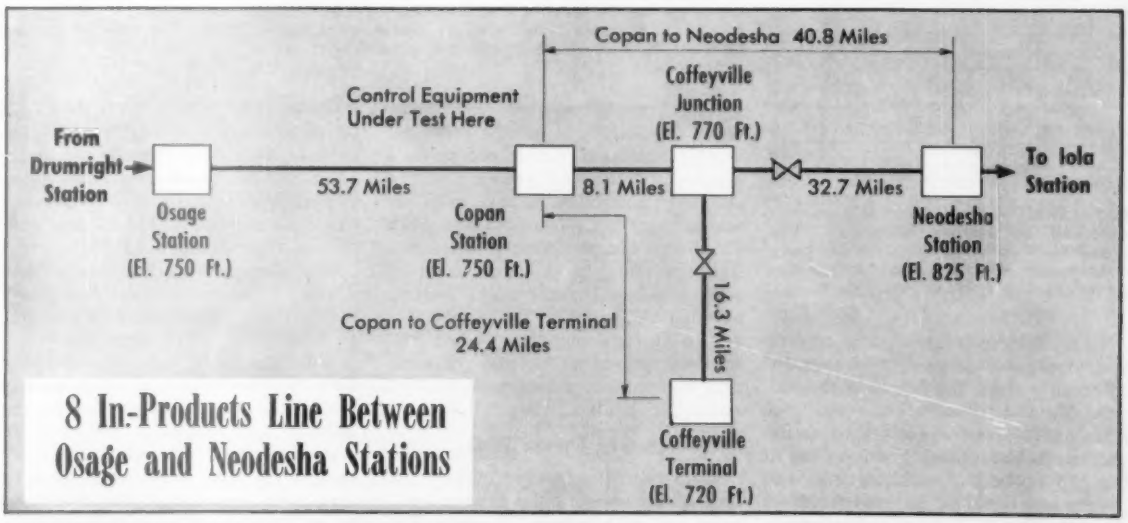
LIGHT-BEAM TRACES from 12-channel oscillograph were used to record the test variables on one rectilinear chart. Use of light traces made it possible for variables to cross each other, as happened when high suction pressures occurred. Fig. 2.

power that has already been generated. Wasted power in turn means wasted money except in those cases where throttling is used to limit electrical demand costs. In addition, throttling reduces throughput, which can result in appreciable lost revenue on a line that is up to capacity.

Therefore, the fundamental philosophy in pipeline control is to throttle only when it is absolutely necessary. Except for load control, the two basic reasons for the existence of a pipeline-control system are (1) to prevent the line from rupturing due to excessive discharge pressure and (2) to avoid cavitation in the pump due to low suction pressure. Under ideal conditions, the control system would call for no throttling, unless the pressures were a threat to either the line or the pump.

It is common practice to back up the control system with high and low-pressure shutdown switches. Should the control system fail to operate satisfactorily, these limit switches protect the line and pump by shutting down the station when the control system fails to keep the pressures within the desired limits.

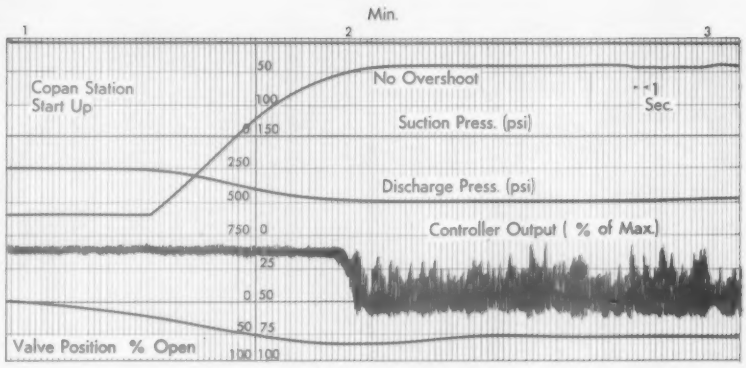
Switch settings. No control system yet devised can always keep the operating pressures between the high and low-pressure controller set points. Therefore, the settings for the shutdown switches must be somewhat above the discharge set point and somewhat below the suction set point. This "gap" between the controller set point and shutdown set point is usually 25 psi. or more with gaps exceeding 40 psi. not too uncommon. The magnitude of this gap is usually determined by how well the control system does its job. The gap must be made somewhat greater than the maximum overshoot the control system will permit in responding to upsets on the line.


Copan to Neodesha 40.8 Miles
Coffeyville Junction (El. 770 Ft.)
Control Equipment Under Test Here
From Drumright Station
To Iola Station
53.7 Miles
8.1 Miles
32.7 Miles
Osage Station (El. 750 Ft.)
Copan Station (El. 750 Ft.)
Neodesha Station (El. 825 Ft.)
16.3 Miles
Copan to Coffeyville Terminal 24.4 Miles
8 In.-Products Line Between Osage and Neodesha Stations
Coffeyville Terminal (El. 720 Ft.)

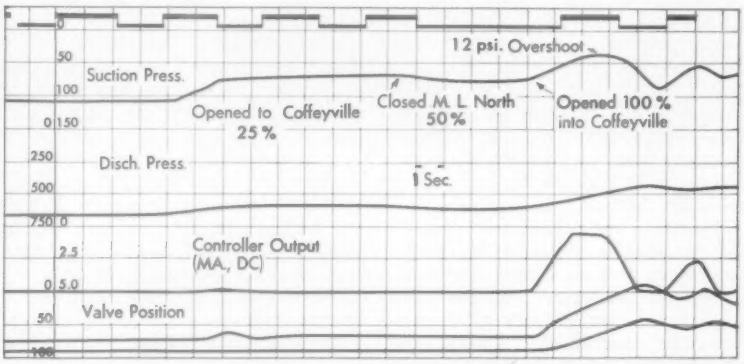
PIPELINE SECTION UNDER TEST, showing relationship of Copan station to the two adjacent stations and the Coffeyville terminal. A wide range of upsets was produced by (1) changing discharge set point at Osage station, (2) shutting down either Osage or Neodesha stations, (3) switching to or from main line at Coffeyville junction, and (4) changing set points at Copan station to make preliminary sensitivity adjustments. Fig. 3.

MANUFACTURER'S EQUIPMENT UNDER TEST
TYPE OF UPSET
INITIAL CONDITION AMPS
SUCTION PRESSURE
DISCHARGE PRESSURE
HEAD PRESSURE
SUCTION SET POINT
DISCHARGE SET POINT
FLOW READING
PRODUCT - STATION LINE
CONTROL SYSTEM (S-D)
ELEC. - SIGNAL
AIR - SIZE SIGNAL LINE
CONTROL SIGNAL
VALVE POSITION % OPEN
MODE SETTINGS
GAIN (PROPORTIONAL BAND)
RESET (R./MIN.)
RATE (MIN.)
FEEDBACK CIRCUIT
PERFORMANCE
OVERSHOOT (PSI)
RECOVERY TIME (SEC.)
CYCLE TIME (SEC.)
PHASE SHIFT (DEG.)
MAGNITUDE RATIO
RATES OF CHANGE
SUCTION PRESSURE
DISCHARGE PRESSURE
CONTROL AIR
VALVE POSITION (%/SEC.)

DATA SHEET for recording information obtained in testing program. This, along with oscillograph records, gave a thorough description of what happened during each upset. Fig. 4.



TYPICAL STARTUP of Copan station where the startup circuit limits the opening speed of the control valve to an opening time of a little over a minute. Valve lined out at a position of a little more than 50% open. When the station went on suction control, the valve was about 85% open. Discharge pressure rose smoothly from 250 to 500 psi. The suction controller took over control with no measurable overshoot. Suction pressure dropped smoothly with no overshoot to less than 50 psi. Fig. 5.



FAST UPSET caused by switching the stream at Coffeyville junction from the main line to the Coffeyville line. When the valve on the Coffeyville line was first opened about 25%, rate action caused a slight movement of the valve, even though the set point was not reached. After the main line was closed, the valve on the Coffeyville line was opened 100%. This caused the control system to go into a stable cycle, with an overshoot of about 12 psi. The rate of change of pressure was about 20 psi. per second. Fig. 6.

It is obvious then that a control system capable of limiting overshoots to small values can increase the capacity of the line because the gap between controller and shutdown set points can be reduced. For instance, if the gap on both the suction and discharge end could be reduced from 40 lb. to 10 lb., the potential throughput would be increased by the additional flow 60 lb. could produce. And the closer a control system can hold line pressures to the set-point limits, the more dependable is its operation.

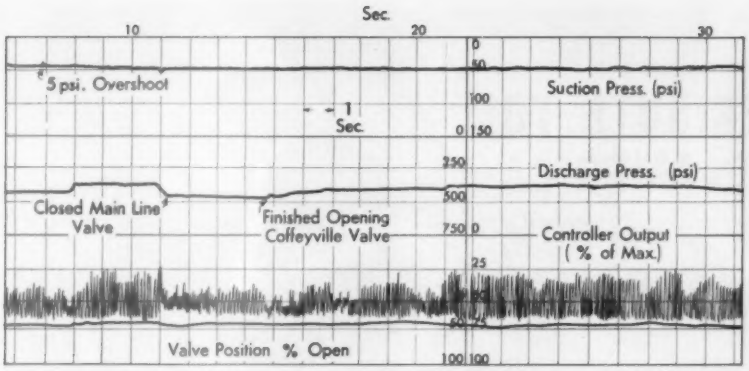
When unusual upsets occur on a pipeline, shutdowns caused by the controller's inability to cope with the situation are not too uncommon. Such shutdowns are particularly costly to a line operating at or near its rated capacity. The general trend towards automation magnifies the importance of such interruptions. When real trouble does occur, it may be some time before maintenance personnel can reach the station.

Setting Up the Tests

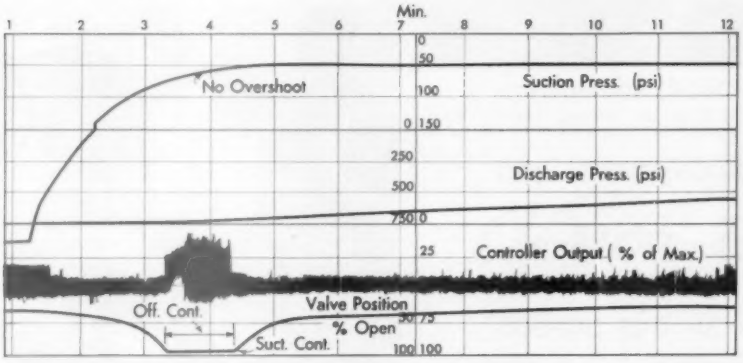
Convinced that a tight control system would improve the general operation of its pipelines, Sinclair Pipe Line Co. investigates the performance characteristics of available control systems on an impartial basis. A number of instrument manufacturers were contacted and asked if they would agree to have their controllers tested at an actual station. Most companies agreed to participate, and seven different control systems were tested. These controllers represented a good cross section of the instrumentation field. Three of the controllers were pneumatic, three electronic, and one was all hydraulic.

Our control-system specifications were simple. We wanted a control system that would never allow the suction and discharge pressures to overshoot their set points by more than 5 lb. This requirement seemed simple, but, because of the wide range of operating conditions in many pipelines, such a specification is quite severe.

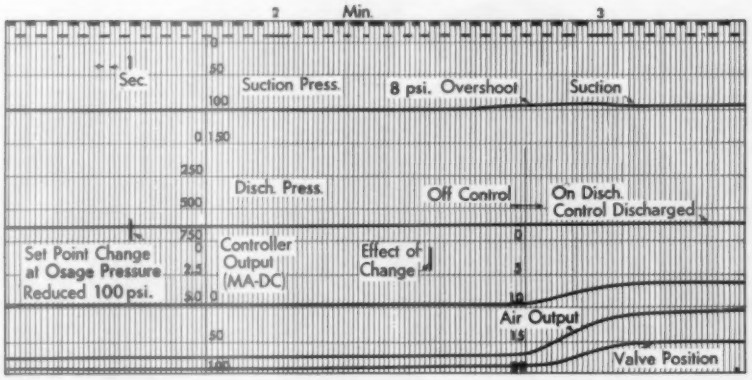
In selecting the station that would



FAST UPSET caused by switching the stream at Coffeyville junction from the main line to the Coffeyville line. The valve was 40% open initially, decreased to 38% open, and finally leveled out at about 39% open. The overshoot on the suction was 5 psi., while the discharge pressure decreased about 60 psi. Recovery from the overshoot was far less than 1 second. The rate of change of pressure was different to determine because recovery was so fast. Fig. 7.



UPSTREAM STATION SHUTDOWN caused this upset. When the suction pressures reached the set-point region, it was changing at the rate of approximately 0.25 psi. per second. There was no measurable overshoot, and the valve was 100% open when control action started. Valve moved from about 30% open to full open in about 2 minutes. Then the system was off control for about 1 minute. When the suction controller took over, valve moved from full open to about 30% open. Fig. 8.



SLOW UPSET caused by reducing the discharge pressure at Osage station by 100 psi. The station was initially off control, and the control valve finally settled out after the upset to a position of 55% open. Air output to the valve dropped from 17 to about 11 psi. The overshoot on suction pressure was approximately 8 psi., and the rate of change of pressure was about 0.2 psi. per second. About 30 seconds was required to recover from the upset and put the station on discharge control. Fig. 9.

be subjected to these controller tests, we chose one that was difficult to control. We felt that a tough test was the best way to find out which control system had the best performance characteristics.

Several reports defining operating conditions at the test station were made available to the participating companies. Conferences were held with representatives, in which the control problem was discussed in detail. Finally, each participating company sent representatives to inspect the test station.

Operating Conditions

The operating conditions common to most liquid pipelines make control to within 5 lb. of the set points difficult. The control system must perform equally well to a given upset from both an "on" control and an "off" control condition. Most control systems are designed to give their best performance from an "on" control condition because in the great majority of controller applications, the system is always "on" control.

This is not generally true in pipeline control. Under desirable conditions, the control valve at a pipeline pump station is wide open and will throttle only when undesirable line conditions exist. It is more the rule than the exception for a pipeline-control system to start from an "off" control condition when responding to an upset.

The nature of pipeline upsets varies considerably. There is a great difference for instance, in the upset resulting from packing the line and the upset caused by a station shutdown. There is a wide range between the slowest and fastest rate of change of pressure which must be controlled. And this wide range of upset conditions can occur from either an "on" control or "off" control condition.

One of the big headaches associated with the pipeline-control problem is the control valve itself. The equal-percentage, double-seated control valve gives about the best available characteristic curve of valve position vs. differential pressure across the valve, but still leaves a lot to be desired. The "gain" or sensitivity of the control loop varies considerably with the position of the control valve.

A pipeline-control valve does very little to control line pressures for the first 30 to 40% of its travel. When in the vicinity of 40% open, however, the sensitivity has increased to the point where a 1 or 2% change in valve-stem position has a significant effect on the line pressures. This condition makes it very difficult to optimize sensitivity adjustments on the

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controller without risking unstable control action.

The startup of a pump station must have special treatment if motor load is to be kept within acceptable limits. This can be handled rather easily in several ways such as limiting the opening speed of the control valve during startup or using a load controller. We felt that the control of startup and load control could be handled by any of the control systems without too much trouble, so our testing was primarily confined to control of the suction and discharge pressures.

Test station. Test were conducted at Copan station, Oklahoma (Fig. 1). This station has one motor-driven centrifugal pump controlled by a 6-in. diaphragm-operated control valve. Fig. 3 shows the relationship of Copan station to the two adjacent stations and the Coffeyville terminal delivery facilities. It is located on Sinclair's 8-in. products line between Houston and Kansas City. Copan has always been difficult to control. It is located 1½ miles from the hydraulic center of the line, causing the station to go on suction control frequently. And switching the stream from the main line to the Coffeyville Terminal line (or vice versa) causes an upset that can be quite severe. This switch to and from the Coffeyville line was the principal method used to check controller response to fast upsets.

The line transports gasoline, fuel oil, diesel oil, and kerosine so that operating conditions vary considerably depending on the location of the products being pumped. The nominal set points on the existing pneumatic control system were discharge, 750 lb., and suction, 40 lb.

The control room is about 150 ft. from the pump. The pneumatic output of the controller is fed directly to diaphragm-operated control valve. The controller itself has a narrow proportional band with no reset and a restriction in the opening direction for slow startup. Set-point pressures will vary as much as 40 lb. under varying load conditions.

Test Apparatus

During the test, all significant variables were recorded simultaneously on a suitable time base so that these variables could be examined critically. The variables measured were suction pressure, discharge pressure, controller output, and valve-stem position. Strain gages were used as primary sensing elements for recording suction pressure, discharge pressure, control air,

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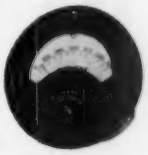

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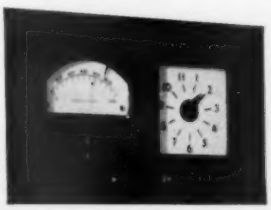

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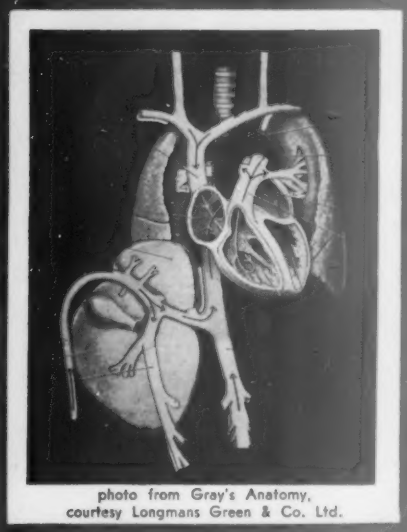

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and hydraulic pressure (for the all hydraulics system).

We designed our own valve-position indicator, and electronic-controller outputs were measured directly from the controller after they had been attenuated to be compatible with the recorder. During the initial phases of the testing program, these four variables were recorded on two dual pen-recording oscillographs that were synchronized by suitable timing pips. By lining up the timing pips on the two charts, the simultaneous effects of the four variables could be studied.

Later, the two recording oscillographs were replaced with a 12-channel oscillograph that uses light-beam traces to record the variables (Fig. 2). This instrument made it possible to record all variables on one rectilinear chart. The sensitivity of the galvanometers in this oscillograph was such that no preamplifier was needed between the strain gages and the galvanometers. The light traces made it possible for variables to cross one another. This was particularly helpful in those cases where high suction pressures occurred.

The scale for the suction-pressure recording was much greater than for the discharge-pressure recording. Therefore, when high suction pressures occurred, they would frequently cross the discharge trace without any complications.

With the first recording arrangement, the chart speeds could be varied from 1 to 125 mm. per second. Chart speeds on the second recording arrangement could be varied from 0.2 to 25 in. per minute. With both arrangements it was always possible to select a chart speed suitable for the type of upset involved. At times as many as five variables were measured simultaneously. This was done on electronic control systems so that the air to the control valve could be measured as well as the electrical output of the controller. In this way the performance of the electric to air transducer could be checked.

Testing Procedure

The most difficult phase of the entire testing program was the development of a testing procedure that would test all instrument manufacturers' equipment on an equal basis. There are many variables associated with pipeline upsets. This makes it difficult to produce two upsets that are exactly identical. Our procedure was to make these upsets as nearly alike as possible with regard to rates of change of pressure, initial valve position, valve stroking time, etc., and run enough

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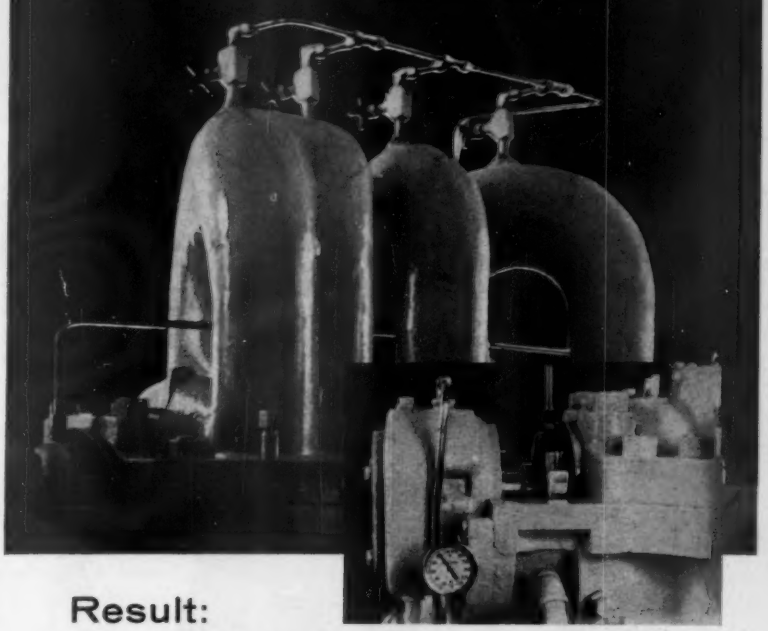

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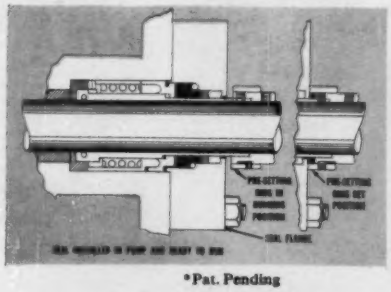

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of these tests to obtain good comparative data.

The test apparatus was essential in making these comparisons because it measured the variables accurately. Fig. 4 shows the data sheet used in the testing program. This data sheet along with the oscillograph records gave a thorough description of what happened during each upset.

Checking a system. After the control system had been checked out and found to be in good working order, it was connected to the pipeline. For the first series of tests, the controller output was dead ended near the control valve with the existing control system still in operation. A series of open loop tests was then conducted by rapidly changing the set point across the suction and discharge-pressure values.

The various sensitivity settings were then adjusted to respond quickly and stably to such upsets. Such false upsets are not too realistic because the controller is not controlling the line, and a set-point change is not identical to a process change. Nevertheless, this proved to be an effective method for getting the sensitivity settings in the ball park.

After these preliminary settings had been made, the station was placed under the control of the new control system. Again rapid set-point changes were made across the suction and discharge pressures and the controller performance checked. The sensitivity settings were then optimized to this type of upset. While this upset was still not identical to a process upset, the sensitivity settings obtained in this manner were usually quite close to the final selected settings.

After these settings had been made, the controller was considered ready for actual performance comparisons. These comparisons were made by subjecting the control system to natural upsets on the line.

Each control system was exposed to a number of upsets to obtain a thorough understanding of its capabilities. It was necessary to subject the control system to slow and fast upsets from both an "on" control and "off" control condition. A special effort was made to keep the rates of change of pressure about the same when conducting similar test on different control systems. When responding to an upset from an "off" control position, it was important to record how far the process was from the set point when the upset started.

The process upsets were obtained in the following ways:

1. The upstream and downstream stations were sometimes shut down to obtain moderate upsets (about 2 lb. per second).

2. The upstream station was started to obtain a rather slow upset (about 0.25 lb. per second).

3. Rapid set-point changes of approximately 100 psi. were made at the upstream station. By the time this surge would reach Copan station it would be a rather long moderate upset (about 2 lb. per second).

4. Switching the main stream either to or from the Coffeyville line was the main basis for checking a controller's response to fast upsets. The worst condition occurred when the stream was switched from the main line to the Coffeyville line because this switch creates a rather sharp drop in line friction.

Since the valves at the junction are hand operated, identical upsets were difficult to obtain. In general, these disturbances were in the vicinity of 20 to 30 lb. per second on the suction side. On one test where we deliberately made the upset as severe as possible, the suction pressure changed at a rate of approximately 100 lb. per second.

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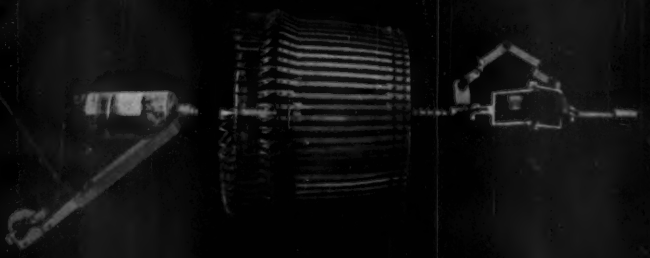

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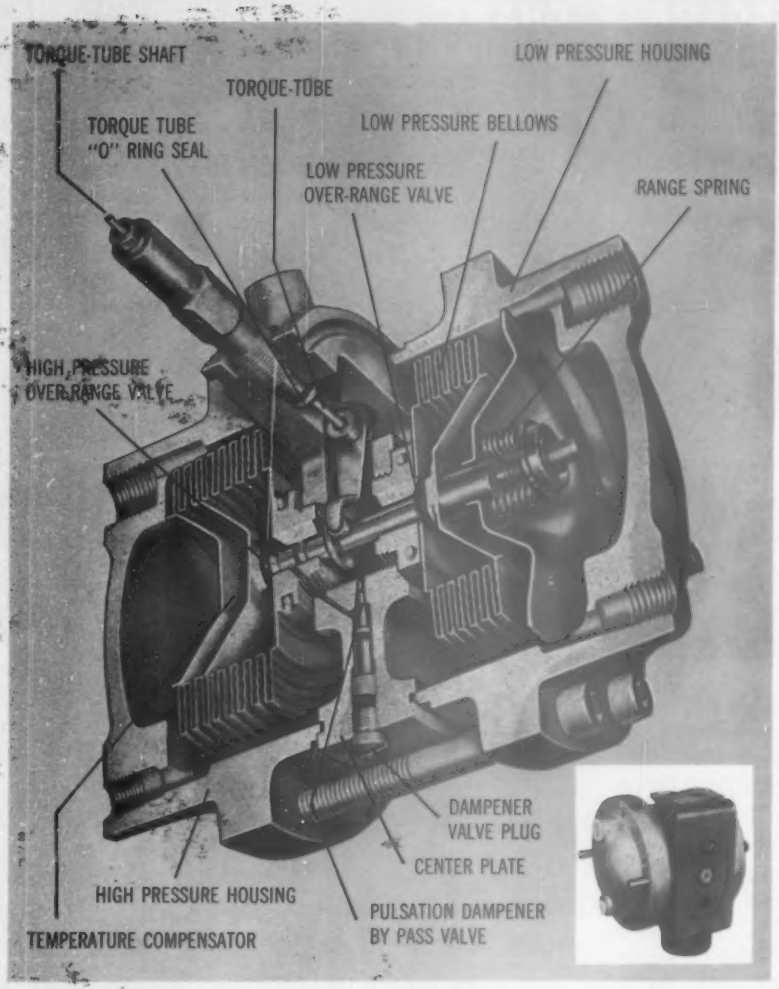

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PIPELINE CONTROL

discharge side of the pump at Copan station. It was not uncommon to have the rate of change of discharge pressure several times as great as the rate of change of suction pressure. This condition was not evident on relatively slow upsets.

5. Controller settings were sometimes adjusted by partially opening a valve between the suction and discharge lines. This would short circuit some of the flow creating an increase in suction pressure and a decrease in discharge pressure. Either the suction or discharge-pressure set point would then be placed close to the process pressure. The valve was then closed quickly and the process would cross the set point at a very rapid rate (30 to 50 lb. per second). This was considered too severe a test of the control system to evaluate its performance, but it was useful in making sensitivity settings.

Except for the all-hydraulics control system, all controller outputs ultimately operated a 3-15-psi. volume booster that supplied air to a conventional air-to-open, diaphragm-operated, double-seated, equal-percentage control valve. The basic stroking time of the valve was 3 seconds closing and 1 second opening. The all-hydraulics control system used a hydraulic-operated piston to stroke the same valve. Its stroking time was 3 seconds in both directions.

Controller Equipment

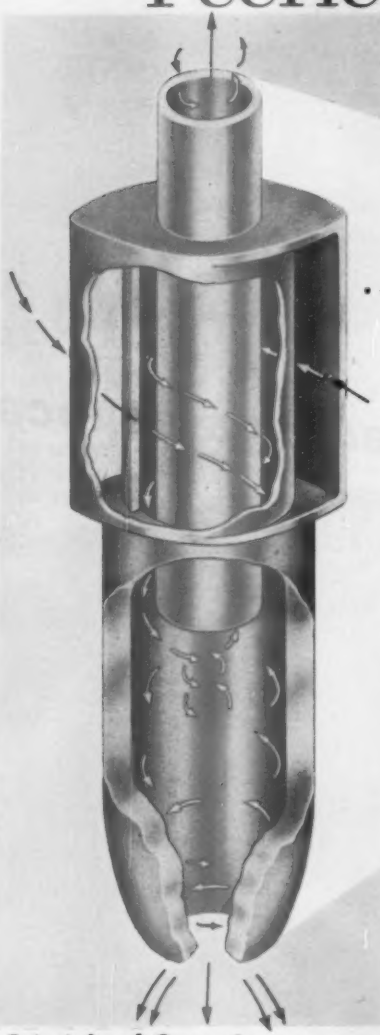
Installing and testing seven different control systems at a station demanding superior controller performance was difficult, and we were quite pleased with the caliber of personnel the various companies elected to send for these tests. The presence of such well-qualified personnel was a major contribution towards a thorough understanding of the pipeline-control problem.

A wide variety of devices were used in an attempt to achieve satisfactory control action. Most companies elected to use a standard three-mode controller as the fundamental control system. This in itself represented a general change in philosophy in pipeline control. Most pipeline-control systems use proportional band (or gain) and reset, but in general rate action has been considered unworkable for pipeline control.

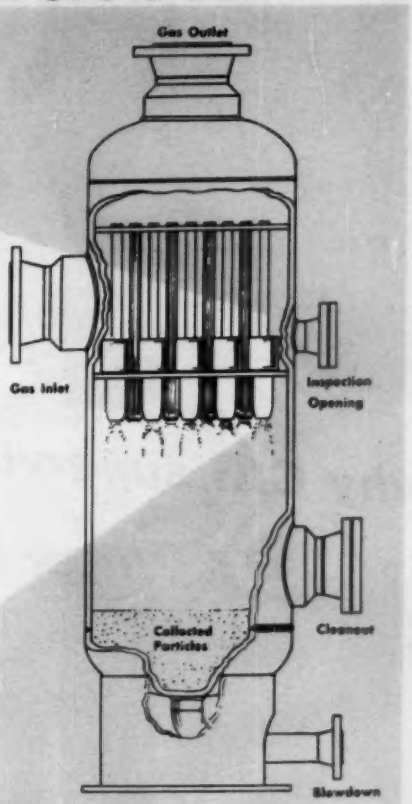
For some time we had felt that true rate action would be advantageous in pipeline control, because it responds to rate of change of pressure only. Such action looked ideal in controlling an upset starting from an "off" control condition because it would start

Another in a complete line of Peerless Scrubbers

Peerless Dry Scrubber



. . . utilizes multiple cyclones to achieve high efficiency removal of troublesome dirt and liquid.



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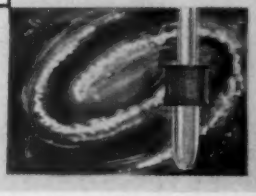

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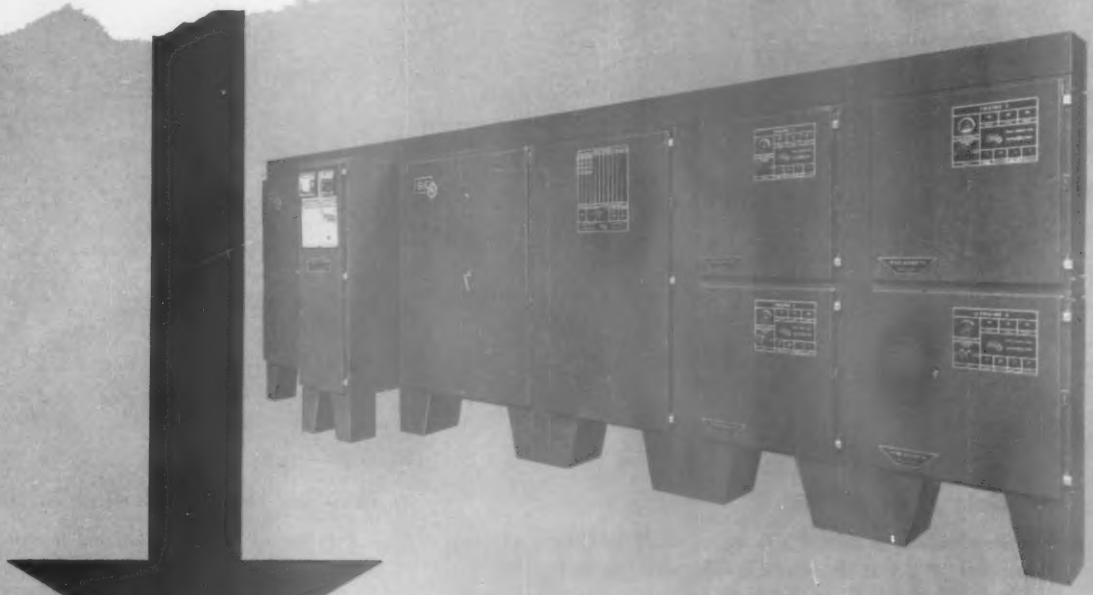

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to stroke the valve before the set point was reached. It appeared that such advance stroking of the valve would be quite helpful in minimizing overshoot.

Previous tests conducted at another station using rate action verified our belief. We knew rate action could be used for pipeline control if proper precautions were taken. Before the testing program was completed, all but one of the control systems employed some form of rate action to their advantage.

Other schemes. Several other schemes were used to give the same general type of control that rate action gives:

1. A batch relay system was used by one company to displace the proportional band on the side of the set point nearest the process when in an "off" control condition. In this way throttling action occurred before the set point was reached by an amount equal to the proportional band width.

2. Another company used a modified form of reset that started control action one reset time ahead of the set point.

3. Still another concern used proportional speed floating action with a very high gain. In this case, control action did not start much ahead of the set point, but the action was quite rapid when it did take over.

4. One company, realizing the disadvantages of the variable gain in the control valve, designed a variable gain circuit that was a function of the valve-stem position. The gain was varied in a way to help compensate for the variable gain of the control valve. This was quite helpful in making the control-loop gain less variable.

Most controller companies used a common feedback system initially. This feature has become almost standard procedure for suction-discharge controllers. Our tests showed that it was an unstabilizing influence in pipeline control and served no useful function. Before the testing program was completed, all companies had modified their equipment and were using isolated feedback.

Many other devices such as capacity tanks, snubbers, etc., were used by the testing companies in their efforts to meet our rugged specifications. All manufacturers modified their equipment in some way before they had completed their testing. This program seemed particularly well suited for exposing any bugs existing in the control systems. In this way most companies were helped because they

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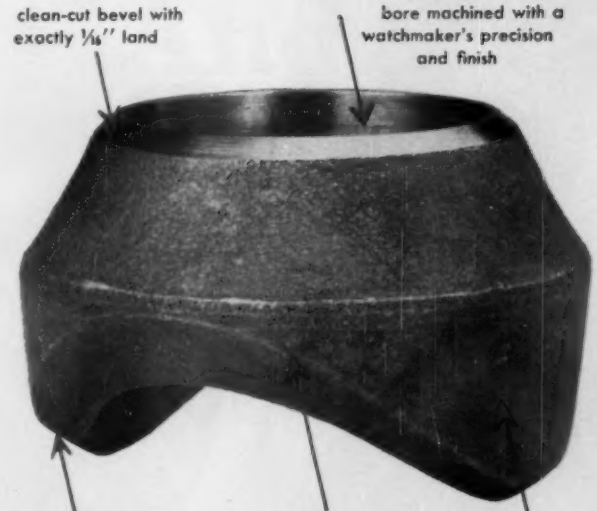
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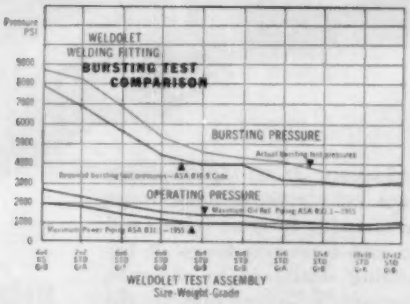

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discovered minor shortcomings in their equipment.

Instrument companies were glad to become aware of such things as an unstable condition when going from suction to discharge control, or an appreciable "bump" when changing from manual to automatic control, or a transmitter sensitive to 60-cycle mechanical vibrations.

Control Systems Performances

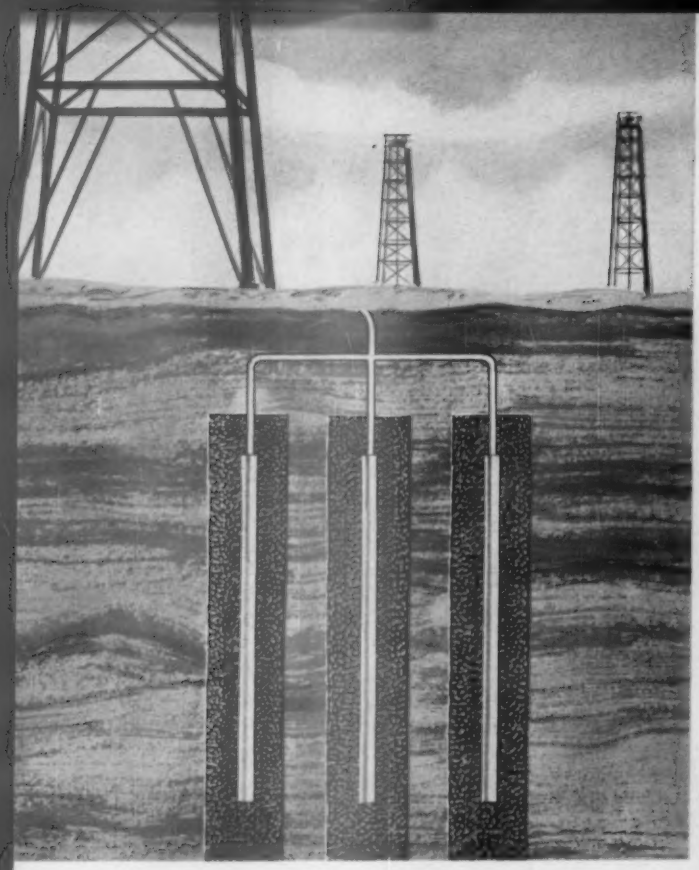
No attempt will be made to single out by type or name which control system did the best job. We were very grateful that so many companies agreed to test their equipment at their own expense on a competitive basis. It would be unfair, therefore, to jeopardize the reputation of any participating company. Furthermore, the best control system today may not be the best one next year and we will keep an open mind about pipeline control.

It is encouraging to note that every participating company has been profoundly influenced by what it learned during this program. In almost every case the companies are working on new designs specifically patterned for pipeline control.

Figs. 5-9 show how several control systems responded to some typical "upsets." These upsets include station start up as well as slow and fast upsets. The table on page 181 shows in a very general way how the control systems responded to both slow and fast upsets. Letters have arbitrarily been designed for each control system.

Only one control system (System E), was able to meet our specifications of staying within 5 lb. of the set point under all reasonable operating conditions. We actually did make this system overshoot 13 lb. by deliberately making a violent upset several times more severe (100 lb. per second) than any other upset in the testing program. This was done primarily to see if the control system could be made unstable. It actually responded to this violent condition in a very stable manner. Subsequent testing has shown no tendency for this controller to go into a divergent cycle.

Most control systems responded rather well to rapid changes even though they did not stay within the 5-lb. limit. All control systems used features that would permit control action before the set point was reached to help accomplish this. In general, these systems did their best job of controlling upsets when coming from an "off" control condition because it allowed time for the controller to



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C*	1½" x 60"	2.0	25	Ground Bed
D	2" x 60"	2.6	46	Ground Bed
E	3" x 60"	4.0	115	Salt Water
G	2" x 9"	0.4	5	Ducts
J	3" x 36"	2.5	80	Salt Water
M	2" x 60"	2.8	57	Salt Water

*Applicable also in fresh water service. Should not be used in ground beds without backfill.

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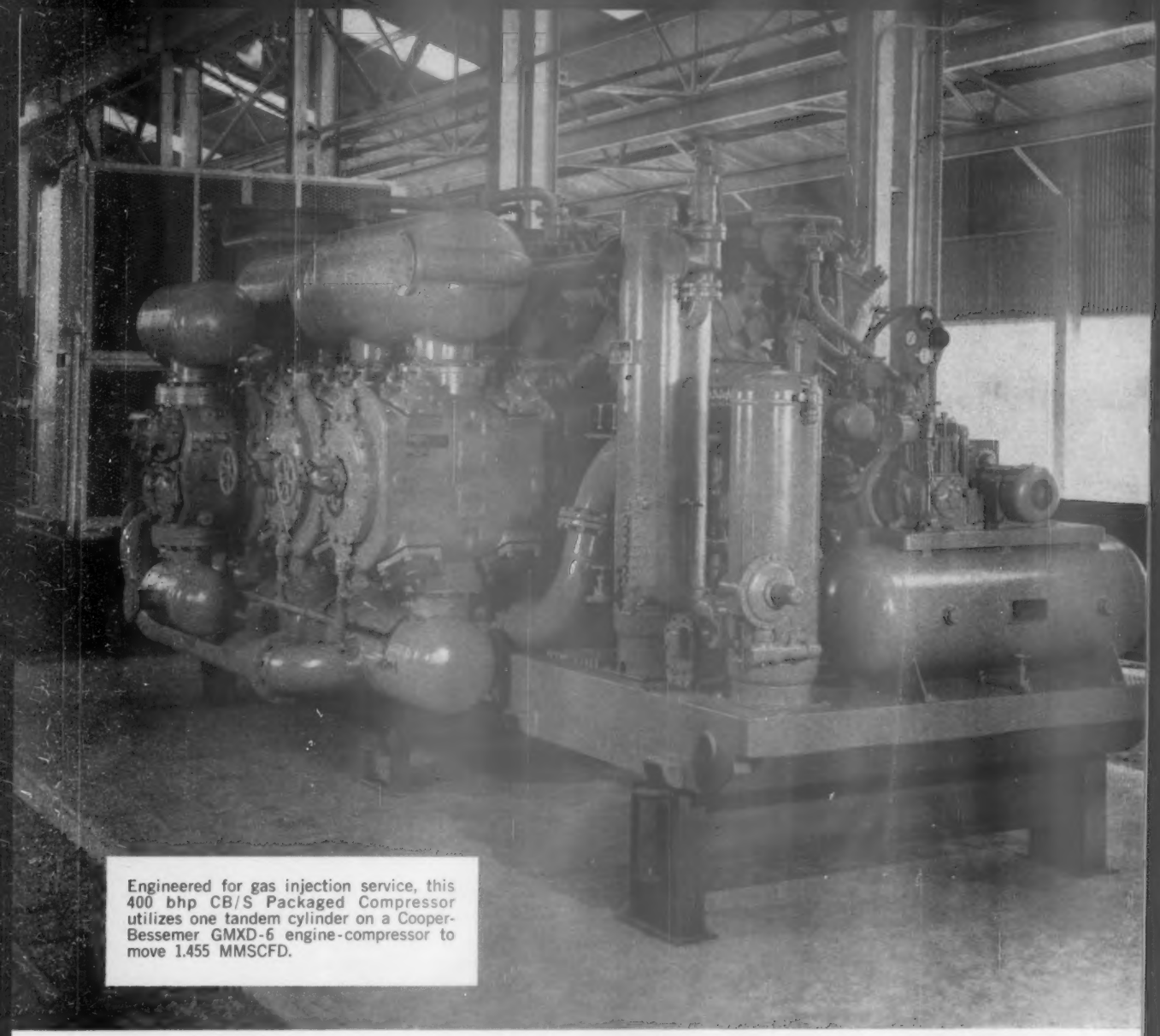

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Control System	Fast changes (> 2 psi./sec.) Overshoot (psi.)	Fast changes (> 2 psi./sec.) Recovery Time (Sec.)	Slow changes (≦ 2 psi./sec.) Overshoot (psi.)	Slow changes (≦ 2 psi./sec.) Recovery Time (Sec.)
A	10	40	2 to 30	20 to 85
B	10 to 17	15 to 70	40	60
C	10 to 17	5 to 40	25	60
D	8 to 10	1 to 10	2 to 17	2 to 45
E	2 to 5(13)*	½ to 2	2 to 4	2 to 4
F	5 to 10	4 to 12	2 to 30	2 to 25
G	45	Divergent Cycle	5 to 15	30 to 55

* This overshoot occurred with a 100-lb. per second upset.

stroke the valve and get it in the control range before the set point was reached.

Conventional pipeline controllers with proportional band and reset do not have this ability to stroke the valve before reaching the set point. Because of this, they permit considerable overshot in responding to an upset from an "off" control condition.

Slow upsets tough. The real surprise came in controller response to slow upsets. This was generally the toughest problem faced by most controller manufacturers. Rates of change of pressure with slow upsets were not large enough to cause rate action (or any of the other schemes that effectively did the same thing) to function. Therefore, no controller action would occur with the conventional controllers until the set point was reached.

Even after the controller crossed the set point, there would be little corrective action unless a lot of reset was introduced. For example, with a 0-1,000-lb. controller, the maximum desirable overshoot of 5 psi. only represents an offset of one 0.5% of full scale. The control valve itself is of little help until it has moved 30 to 40% of its full stroke. These combined effects of limited allowable offset, and poor control-valve characteristics made it extremely difficult to add enough gain and reset to do the job without risking an unstable control system.

By the time most of the control systems were made sensitive enough to give a reasonably good performance for both slow and fast upsets, the controllers were not too far from instability. We had the feeling it would be risky to leave such systems unattended for fear they might go into a divergent cycle when exposed to certain severe upsets.

Features of Good Control System

It took about 6 months of testing to check the performance of the seven control systems. During this time almost every conceivable operating condition was encountered. Each controller manufacturer tried to solve the same basic control problems in a somewhat different manner. These tests, therefore, gave us an excellent oppor-

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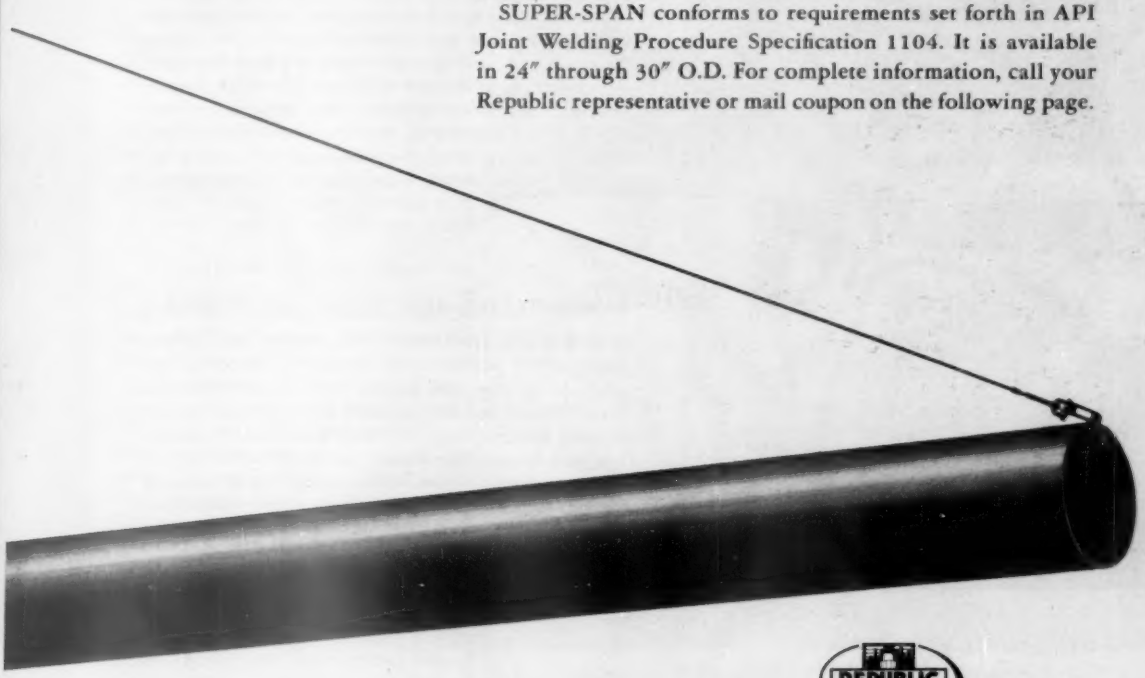

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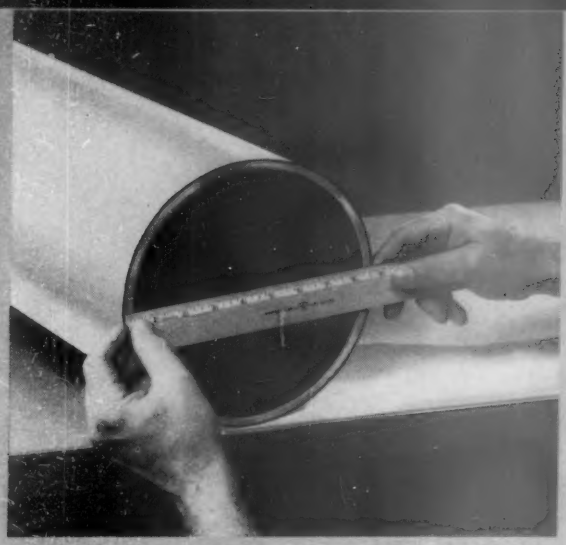

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tunity to observe what type of control systems worked well under a variety of conditions.

The net result of all this elaborate testing, in addition to finding an acceptable control system, was a genral understanding of essential controller characteristics for good pipeline control. These essential characteristics are:

1. To minimize unwanted overshoot in responding to fast changes from an "off" control position, the controller must be capable of stroking the valve before the set point is reached. If rate action is used to accomplish this, pressure variations caused by line turbulence must be filtered out before reaching the controller.

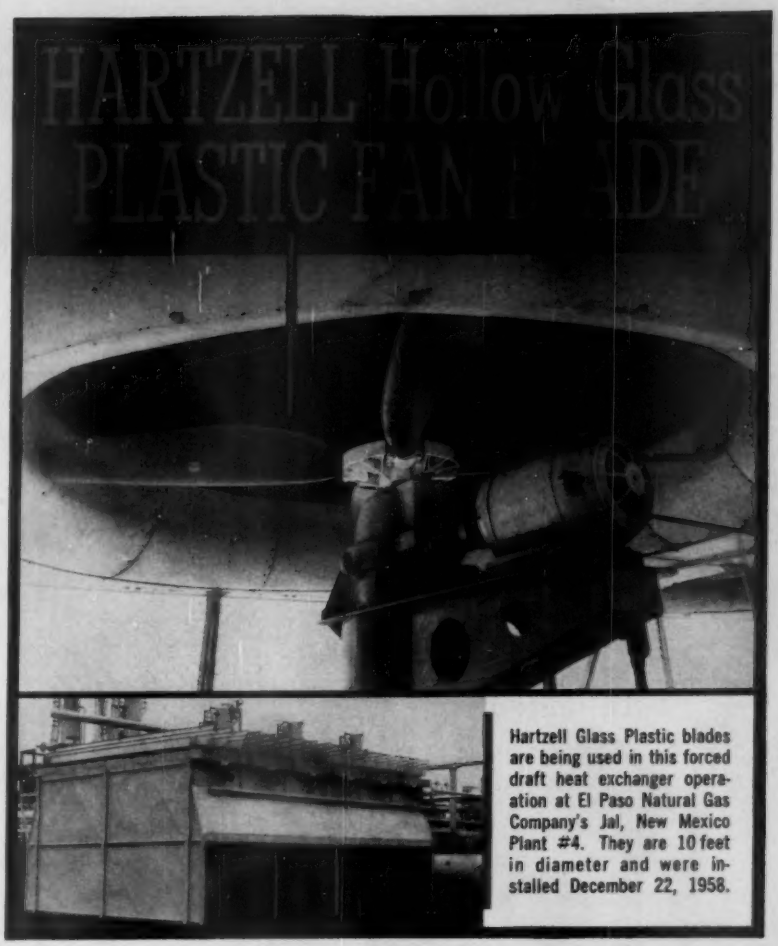
If this is not done, the controller will attempt to respond to these pressure variations and instability will result. In all probability, rate action for pressure control has been avoided because of difficulties encountered by this turbulence. However, our tests demonstrated that rate action can be used successfully wehn the turbulence is filtered out.

Filtering out turbulence does introduce a time lag which in itself has a limiting effect on the maximum allowable rate action. This effect may or may not be significant depending on operating conditions. When proportional speed floating control is used, the control action has to be quite rapid because such a control system does not start throttling action very much ahead of the set point.

2. Regardless of the control system, the control valve must always be capable of changing pressure on the line at a more rapid rate than the rate of pressure change of the worst upset condition. Otherwise the control system does not have control of the process. For our condition, a basic stroking time of 3 seconds appeared to be adequate. Other lines may demand faster or slower speeds depending on individual operating conditions. However, it is felt that in many cases control valve traveling times are much too slow.

If the control-valve speed is too slow for line upsets, no control system can possibly give satisfactory control action. There seems to be a general reluctance to demand really fast stroking speeds for control valves, with the result that the controller is limited in what it can do. One explanation for this reluctance is the fear that fast stroking valves will introduce dangerous surges.

Our tests show that a fast control valve operated by a good control system will eliminate surges, not create



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PIPELINE CONTROL

them. On a previous test we reduced the stroking time of a 14" control valve from 31 seconds to 4 seconds and improved controller performance considerably.

3. All lags in the control loop must be kept to an absolute minimum to obtain fast stable action. This was demonstrated on many occasions during the testing program. A series of relatively small lags can be deadly when adjusting a control system for fast response. The net result of such lags can frequently produce enough phase shift during an upset to cause the system to go into a divergent cycle.

4. A suction-discharge controller will give a better performance with an isolated feedback system than with a common feedback system. The generally accepted view that common feedback is desirable in such cases. Four different control systems, two electronic and two pneumatic, initially used common feedback. Field tests proved that the controller was more stable and in some cases faster when the feedback was isolated.

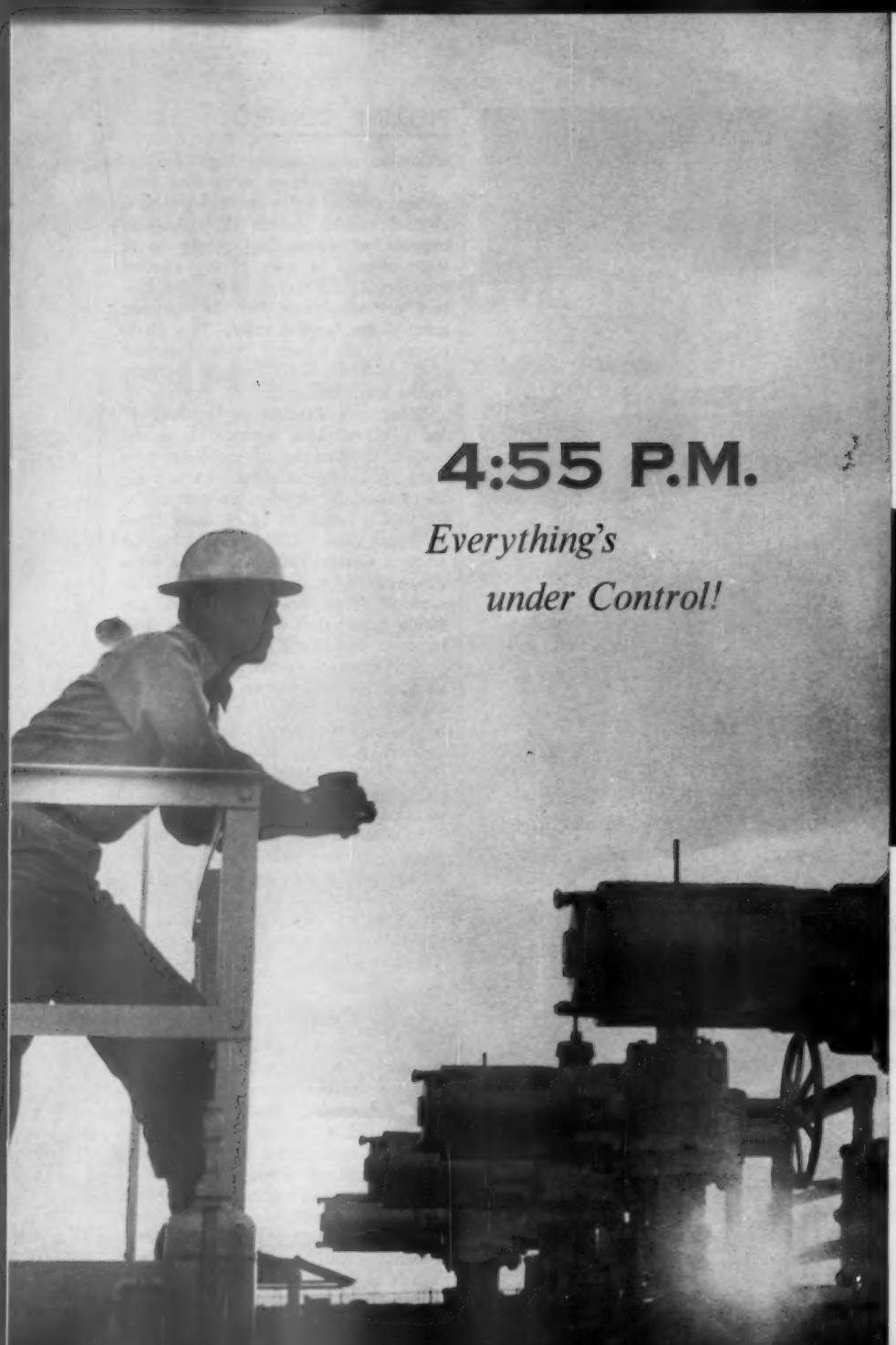
As a result, every instrument company involved elected to use isolated feedback. This minimized interaction problems when going from suction to discharge control (or vice versa), because the suction and discharge controller were operating independently of one another.

5. Controllers should be designed so that it is easy to make accurate set-point adjustments. The set-point scales were too coarse on some control systems to position the set point accurately. In addition it was not uncommon for set point and process pointers to be offset somewhat.

If the controller set point is only 5 lb. away from the shutdown set point, the controller set point must be capable of accurate adjustment if trouble is to be avoided.

6. The output signal of a control system should be only a little greater than the value needed to stroke the control valve 100% of its travel. For instance, if a pneumatic system strokes the control valve from 3-15 psi, the maximum output of the control system should be slightly greater than 15 psi. If the controller is allowed to "wind up" its signal to a value much greater than 15 psi., it means unnecessary delay in stroking the valve when coming from an "off" control condition.

It has not been too uncommon to allow controllers to sharply exceed their rated outputs. Recently instrument manufacturers have become increasingly aware of this problem and have taken steps to correct this con-



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7. As long as we must live with present control valve characteristics, a control system should (1) either be capable of responding stably to a wide change in gain of the control loop or (2) have a variable gain feature to compensate for the variable gain of the control valve. This characteristic of pipeline control is the one most frequently ignored by controller manufacturers.

When a controller is "optimized" for a given valve position, it is not optimized when the valve changes position. A change in control-valve position frequently changes the gain of the loop by a factor of 10 or more from its initial value. There were occasions when a control system that had been adjusted for stable response in one control valve position became unstable after the valve position had changed significantly.

8. A control system should be no more complicated than necessary to do the job. If a control system is made unnecessarily complicated the possibility of the controller fighting itself increases tremendously. A simple control system is generally easier to adjust and maintain.

9. The control system should be capable of slow start up so that the pump drive is not overloaded during this condition. Consideration should be given to motor-load control for lines in which widely different fluids are pumped to minimize demand when heavy viscous liquids are pumped.

Program Benefits

This testing program was quite beneficial to both Sinclair Pipe Line Co. and the participating instrumentation companies. Sinclair Pipe Line Co. found a control system which, from all indications, meets the rigid requirement of staying within 5 lb. of the set point under all reasonable operating conditions. In addition, Sinclair learned a great deal about pipeline control and had the advantage of observing a number of different control systems in operation.

The instrument companies had the opportunity of making a detail study of pipeline-control problems. All the participating companies learned a lot about pipeline control. Most representatives left with the feeling that they now had a clear understanding of our problem and had definite ideas for redesigning their equipment to meet our needs. Most of the participating companies are now actively engaged in programs to determine how to design a system to more nearly meet pipeline service.

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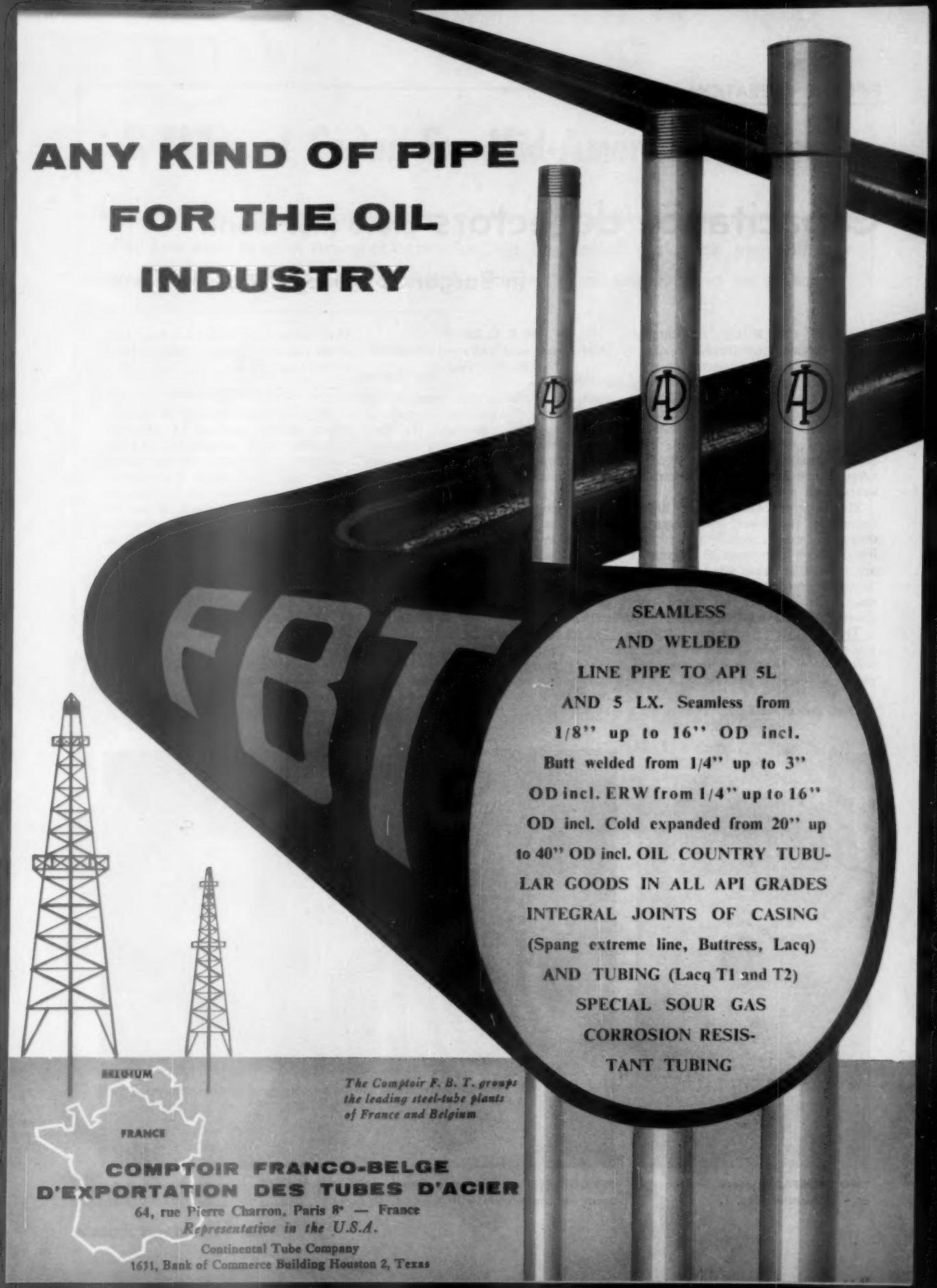

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Capacitance detectors prove their worth

in Borger-to-Chicago products line

BY R. C. REILLY
Chief Electric and Instruments Engineer
Phillips Pipe Line Co.

OUTSIDE OF BUGS encountered during original installations, capacitance-type interface detectors have been performing satisfactorily on Phillips Pipe Line Co.'s Borger-to-Chicago pipeline system. These instruments do not require any unusual amount of maintenance. Only the periodic calibration checks and other routine maintenance associated with electronic instruments are required.

The interface detectors are highly vulnerable to power and telephone outages; however, records indicate this has not been a problem. The detectors are located in areas where there are excellent power and telephone facilities available. And the leased telephone lines are relatively short.

The interface detector has a definite place in pipeline operations, and it will play a major role in the completely automated pipeline.

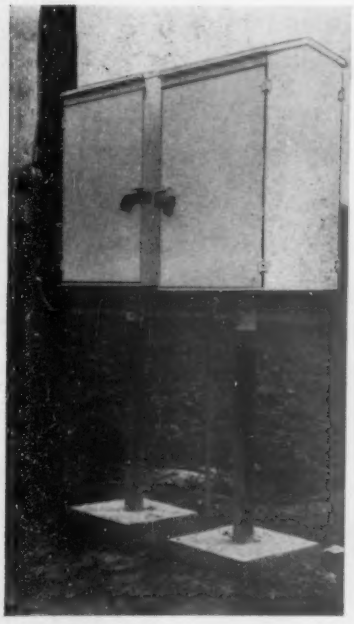
Oral communication. For many years our pipelines have operated by depending on word-of-mouth progress of the various slugs along the line. Each station upstream of a terminal was equipped with a gravitometer and it was this station's responsibility to report gravity changes to the terminal. By knowing what time a certain product cleared the upstream station, the terminal operator could calculate when it would arrive at the terminal. At that time he would wait for the gravity to break on the terminal gravitometer and then make his switch.

This arrangement worked out fine if the upstream station reported the gravity change; if the rate remained fairly constant; if the operator taking his vigil at the terminal gravitometer allowed himself a wide margin of time to be certain not to miss a switch; and, if the operator did not make an error in his calculations.

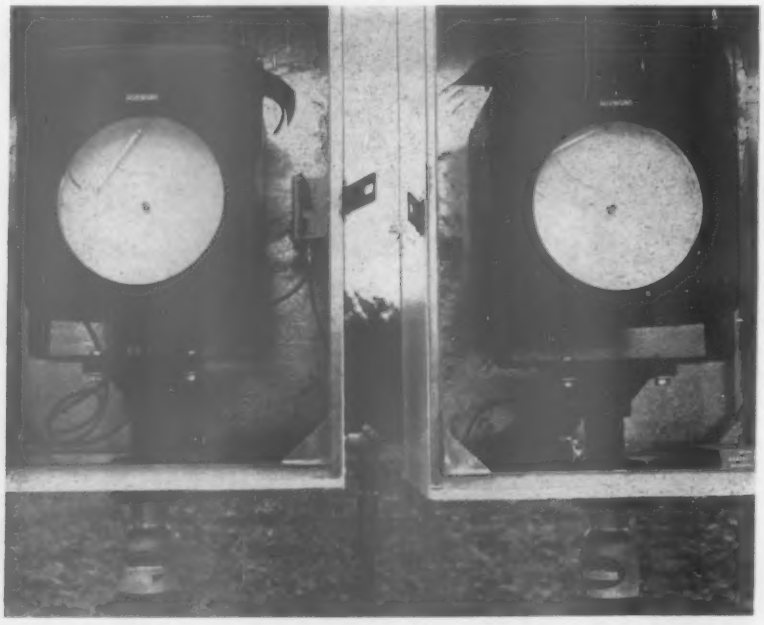
Capacitance Units

To keep these variables to a minimum, several methods of detecting interfaces were investigated and we decided to experiment with the capacitance type. The liquid gravitometer we were using could not be used for remote indication because of the distance involved between the upstream and terminal location. It also required a differential means.

Capacitance type of interface detection was being used extensively by our production department as a b.s. and w. monitor on crude-oil systems, and the pipeline had been using capacitance detectors for years in detecting water level in separators. A team from our research and development group installed, at one of our main-line terminals, a b.s. and w. monitor which



TWO INTERFACE systems are required at each location. Fig. 1.



PERIODIC CHECKS are made at the upstream location by recording the pen movement for comparison with terminal recorder.

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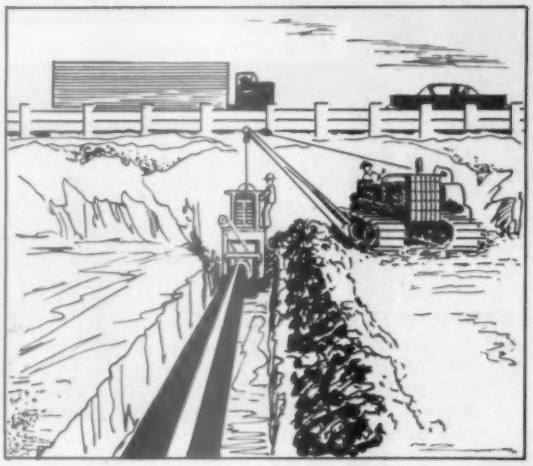

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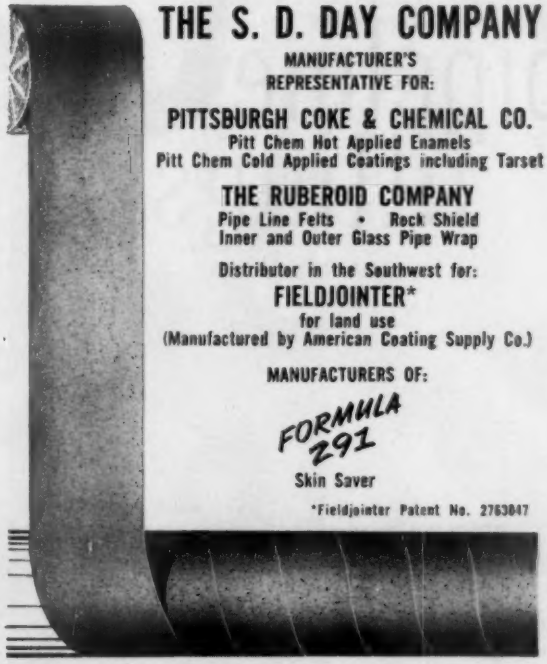

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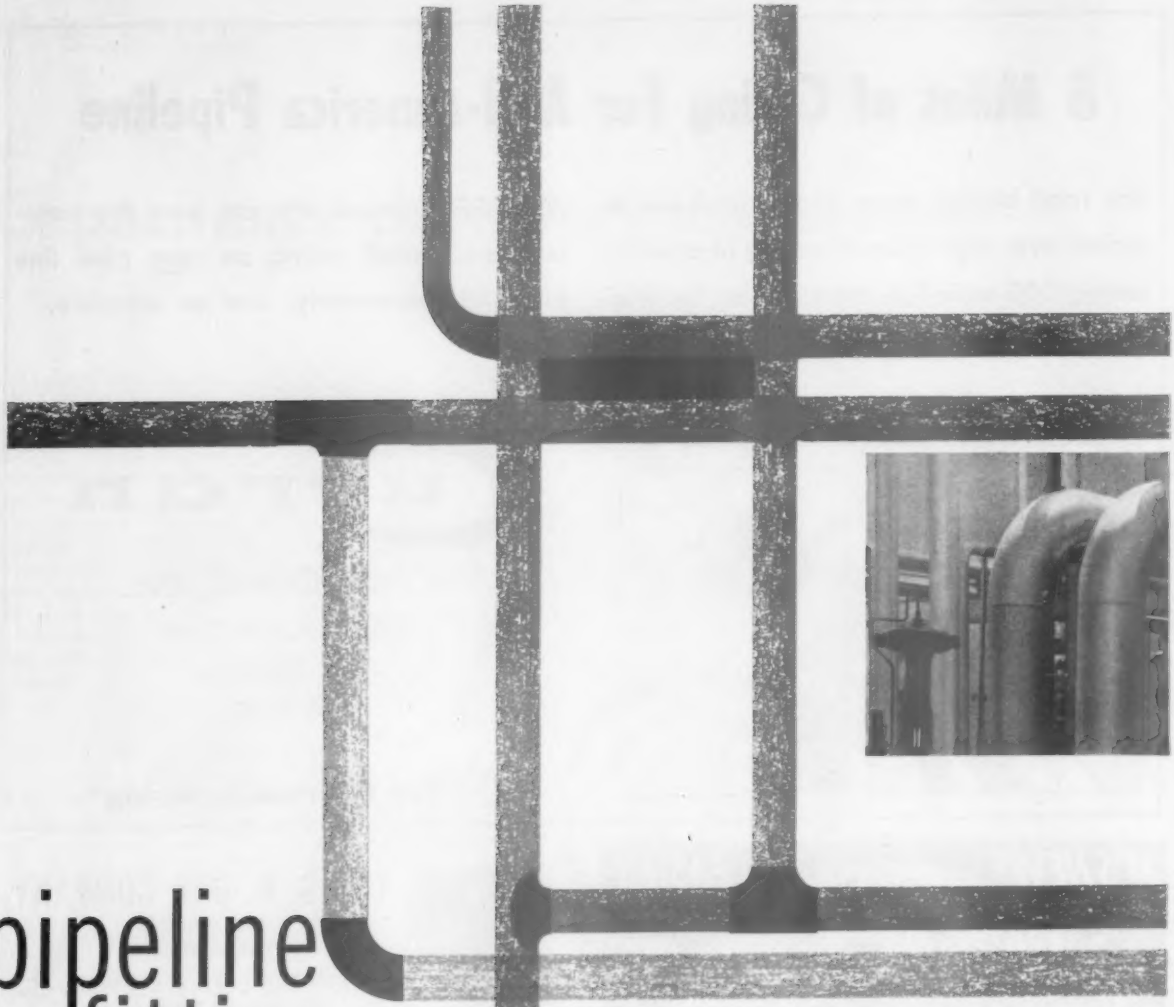

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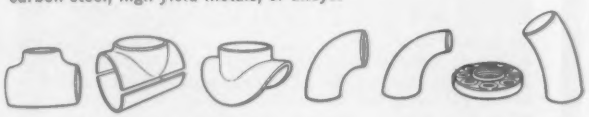

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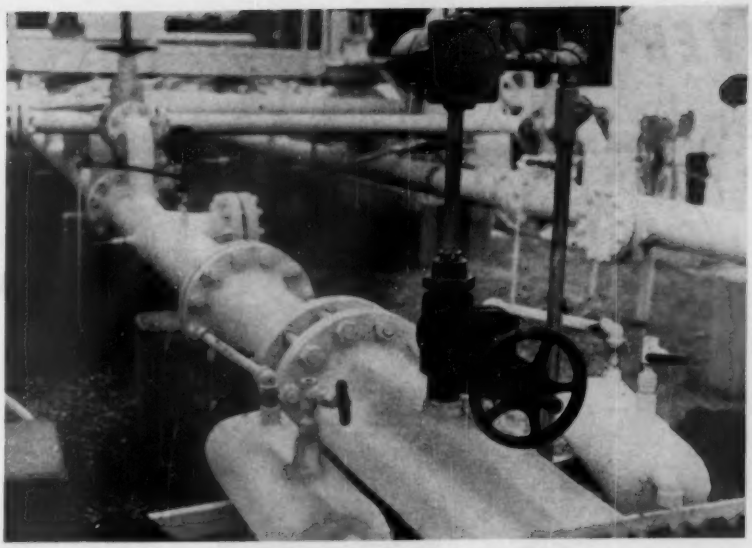
had been adapted for recording changes on a products line.

Records from the monitor and from a gravitometer were compared and it was proved that this was a practical approach. With this information, we installed our first interface detector at our East Chicago terminal which is the termination of our Borger-Chicago pipeline system.

Since one probe and one recorder at the terminal would have had very little advantage over the dependable gravitometer, one probe and instrument, along with a telemeter transmitter, were installed upstream from the terminal and a second probe and a two-pen recorder with a telemeter receiver were installed in the terminal yard.

The upstream probe was installed in a bypass around a valve. The differential across the valve is sufficient to assure flow through the bypass. At the Chicago installation this worked out satisfactorily, but troubles were encountered as we proceeded with installations at other terminals.



TERMINAL PROBE is inserted directly into the line. Terminal measuring instrument can be 516 ft. from the probe. Fig. 3.

Locating upstream probe. To gain the maximum benefit from the upstream probe, it should be located at a distance from the terminal at least equal to the time required to display a complete interface record to the terminal operator before the head end of the interface arrives. On the average, this amounts to a minimum of 30 minutes and a maximum of 1 hour depending on the operating rates. This is approximately 2½ to 3 miles of pipe. It was a rare case indeed that a valve or other differential means, power and telephone services were all available at the right place to meet the above conditions.

Since scrapers are not used on the Borger-Chicago line, we decided to insert the probes directly into the pipeline thereby making the selection of the upstream location much more flexible. A tool was developed for inserting and removing the probes under pressure which eliminated the necessity of shutting down the pipeline for making the installation or any servicing required at a later date. By using this method, power and telephone-line availability are the only limitations in selecting the upstream location.

If aboveground piping is not available, a steel box is welded to the pipe-

INTERFACE chart correctly indicates passage of an interface at the upstream location followed by the arrival of the interface at the terminal. Fig. 4.

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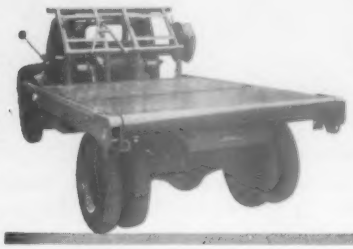

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line for housing the probes. The Borger-Chicago system consists of two lines, each line handling a different product; therefore, two interface systems are required at each location (Figs. 1 and 2).

Upstream instrument. Normally a chart is not required at the upstream location because the information is telemetered in to the terminal recorder. However, periodic checks are made by recording the upstream pen movement for comparison with the record at the terminal. This serves as a check on the telemetering system.

The upstream instrument is mounted in a weatherproof meter house with a blank front to discourage target practice. In the areas where there is a good possibility of such vandalism, steel plates are bolted inside the house to deflect small-caliber shells. To date there has been no tampering whatsoever with the equipment at the upstream locations.

The measuring instrument in the terminal can be located a maximum of 516 ft. from the probe which is also inserted directly into the line (Fig. 3). (The upstream installation would be similar if aboveground piping were available.) The two-pen recorder is not explosionproof; however, the 516 ft. usually allows it to be located in a nonhazardous area. If this is not possible, the instrument is equipped for air purging.

Terminal alarms. The terminal operator now receives an alarm when the gravity breaks at the upstream location. This alerts him to the fact that a product change in his terminal is imminent. Before the interface arrives, he will have a complete record of the gravity break and can decide at which point he should make the switch. Then by setting an alarm index on the terminal pen, he will receive a second alarm when the gravity reaches that point.

The same contacts that give him the second alarm could, of course, be used to actuate valves to make the switch automatically. We have not, as yet, installed such automatic switching equipment.

The operator in Fig. 4 is holding a record of an interface previously recorded. The chart clearly indicates the passage of an interface at the upstream location followed by the arrival of the interface at the terminal. This particular chart recorded two interfaces in the 24-hour period. The charts on the recording instruments indicate the same reading at the upstream location as in the terminal (both pens together).

The push button and pilot lights at the top of the instrument in Fig. 4

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are used as follows: When the operator receives the alarm that the gravity is changing at the upstream location, he can silence the alarm by pushing the horn silence button, but the pilot light will remain lit to serve as a visual reminder that a gravity change has occurred at the upstream location.

The operator will receive the second alarm when the station pen crosses the index setting. He can silence the second alarm by pushing the local horn silence button, and the terminal (local) pilot light remains lit indicating a gravity change is taking place in the terminal. After the change has been completed and both pens are recording the same gravity, both pilot lights will go out indicating everything is normal.

The telemetering system works over a low-grade telegraph circuit (0-15 PPS) which is the most economical to lease. Also the power requirements at the upstream location are very slight (50 watts) which generally falls in the minimum classification. This information is now being telemetered to the terminal only; however, the information from the various locations could be brought into a central control point.

We now have 12 such systems installed and we feel they have proved to be a valuable tool to the dispatcher and to the terminal operator.

Dispatching aid. The detectors have served as a dispatching aid by providing advance information of the slug movement into a terminal and the amount of interface that must be received into interface tankage. It also allows the dispatcher to readjust his control sheet in the event the meter readings have been in error and reduces deration time for handling special products because of the different rates in two sections of the line.

By knowing to the minute when a certain slug will clear a particular section, the dispatcher can increase or decrease the rate at that time without any lost motion. At one location an intermediate terminal must take heart cuts of propane. In this case, without the detector, it would be necessary to wait until pure propane arrived at the next downstream terminal, some 6 miles down the line before informing the intermediate terminal to cut in.

With the detector, the dispatcher can tell the intermediate terminal exactly what time the valve should be opened thus allowing the terminal to proceed with preparations.

On the various sections of the pipeline it is not unusual to be receiving into storage from one section of line and pumping out of storage to another section. When the time arrives to switch one section to the other sec-

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tion, the detector, by recording the interface in advance, allows the dispatcher to switch the line with assurance he has held contamination to a minimum.

Operator's aid. The detector has proved very useful to the operator because he is no longer required to spend extra time waiting for a product change. He can go about his other assigned duties with the knowledge the detector will alert him of an impending change. Also by having the complete interface displayed, he can decide exactly where he should make the switch and also know how long he will be receiving into interface storage before the arrival of a constant gravity.

In the case of one of our terminals which must take off all the propane interface for refractionating, the advance alarm allows the operator to figure exactly what time to make the switch. If he misses a propane switch, the interface material must be disposed of at another downstream location at a loss or shipped back by transport truck for refractionation. In either case, a missed switch would be very costly.

The capacitance-type interface detector has also been used for testing the efficiency of controls on our partial loops. In the past, the loops have been checked by inserting dye at the beginning of the loop, then pulling samples at the end of the loop to determine if the dye had arrived at the end of each line simultaneously. This method proved fairly satisfactory but had definite limitations in that dye could not be inserted in all products. Also it was essentially a daytime project to allow the man pulling the samples sufficient light to determine the arrival of the dye. Furthermore, the human element was always present in that one person can determine a color change more readily than another.

By using battery-powered measuring circuits and spring-driven recorders mechanically linked to insure that they will both run at the same speed, it is possible to record the arrival of an interface in the two lines at the end of the loop and measure exactly the difference in time between the lines. Any necessary adjustments on the loop controller can then be made. The main advantage of this method is that the recorders and an ordinary car battery can remain at the end of the loop unattended and record as many interfaces as required.

After one loop has been tested and adjusted, the entire gear consisting of two probes, two measuring circuits, and two recorders can be very easily loaded in a car and moved on to the next location.

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Remote control is feature of gas-turbine compressor station

This and later installations will cut first costs and operating costs, increase reliability of Tennessee Gas system

BY ROSS O. PARKER, JR.

. . . assistant chief engineer of Tennessee Gas Pipeline Co., a division of Tennessee Gas Transmission Co.

Parker graduated from Stephen F. Austin College in 1936 with a BA in mathematics and accounting, and from Rice University in 1941 with a BS in electrical engineering.

AS A SYSTEM is expanded, installation and operating costs go down and reliability goes up if remote control is worked into the system. Tennessee Gas Pipeline Co. found this to be so when it installed a master station to go along with an existing gas-turbine compressor station.

Based on experience gained in this and other operations throughout its system, the company is going ahead with a computer-controlled station. It will be in operation this year.

The two existing units operate in series. The second or master station has been in service since late 1959. It was based on knowledge and experience gained from a year's operation of the initial unit, now the remote station.

Remote location. The remote station near Alexandria, La. is located 65 miles from the master station near Kinder, La. (See map). The information is transmitted between locations via microwave operating in the 6,000-megacycle band.

The prime movers are two-shaft, regenerative - cycle, base - mounted, 6,700-hp. gas turbines driving centrifugal compressors. (Fig. 2). In addition to the protective devices furnished by the equipment manufacturer, it was deemed necessary for safe operation to add safety shutdown devices for high discharge gas pressure, high discharge gas temperature, excessive vibration of the turbine and the centrifugal compressor, and detection of fire.

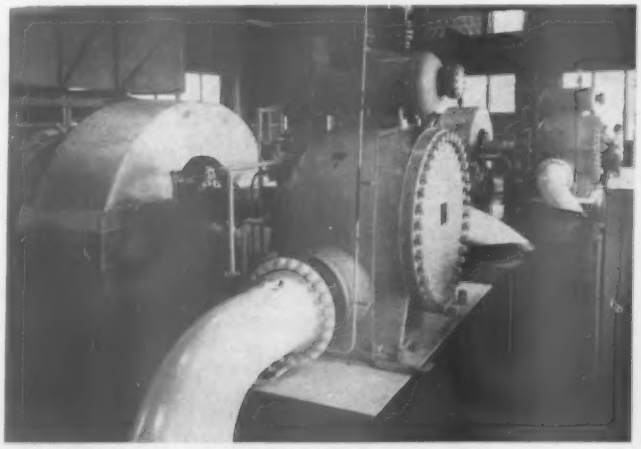
Although the prime movers are remotely controlled there are many functions that are performed manually, requiring an around-the-clock utility man. His functions include operating the auxiliary generator units and checking the safety devices, control batteries, and the instrument air drier.

In addition, he does routine maintenance work within the station yard, manually operates the prime movers when loss of transmission circuits occurs, and pressurizes the yard piping after the station has been shutin and bypassed due to a station emergency such as detection of fire or loss of a.c. power and compressor-seal-oil level.

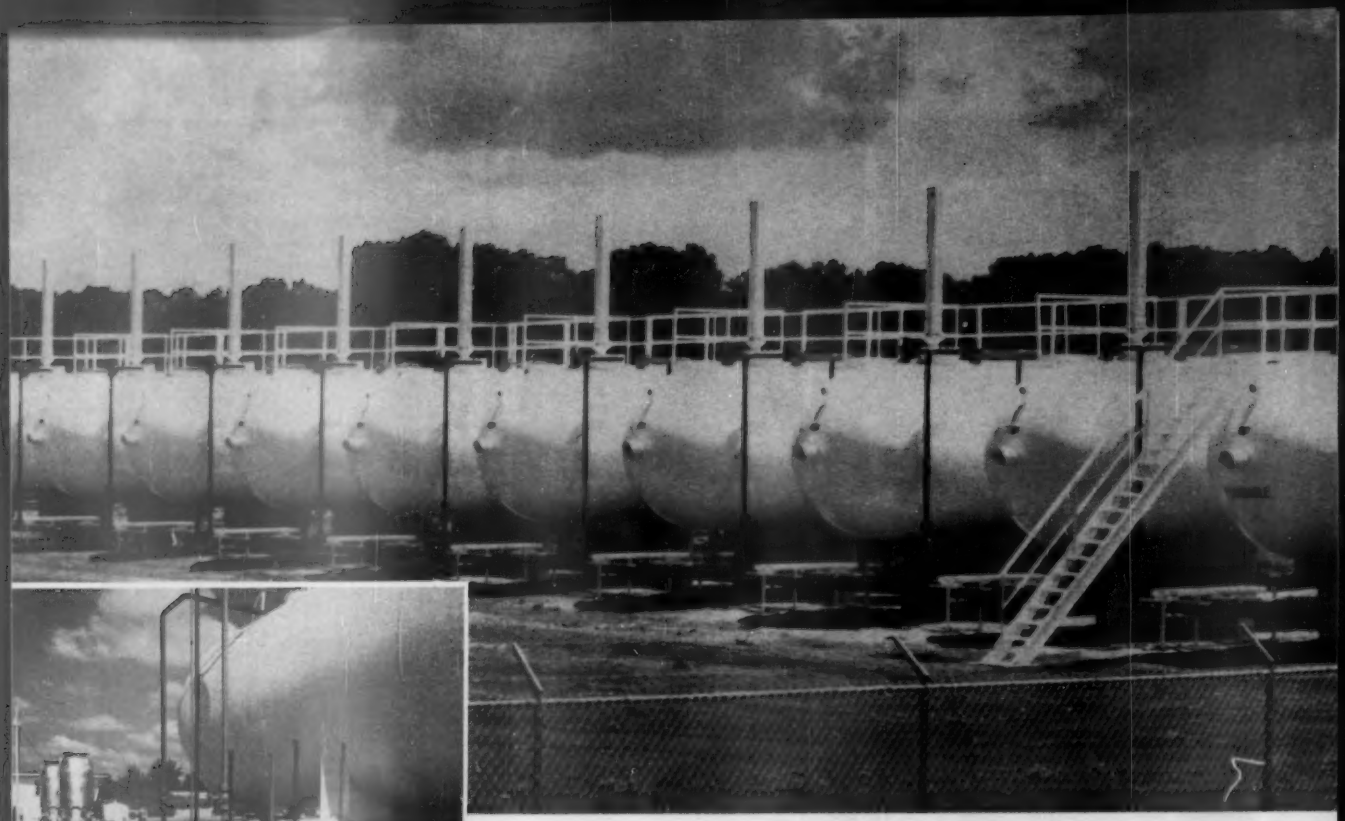
Remote data. To operate the remote station efficiently and safely from the master station, certain information is required. This includes suction and discharge pressure, gas flow, the two-shaft speeds, average exhaust temperature, and the axial compressor discharge pressure for each turbine. This knowledge is collected at the remote station in analog form, i.e. in impulse-duration signals.

The impulse-duration signals are

CONTROL AND REMOTE STATIONS of Tennessee Gas Pipe Line Co. Fig. 1.



TWO-SHAFT REGENERATIVE cycle gas turbines driving centrifugal compressors in series. Fig. 2.



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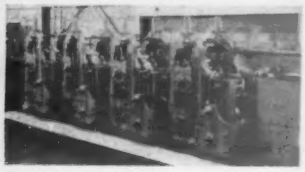

SIZING STANDS

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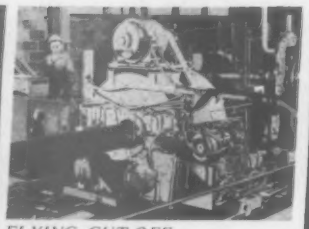
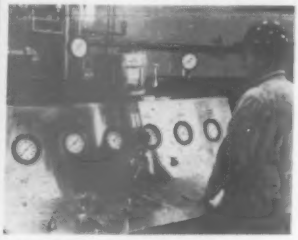


FLYING CUT-OFF

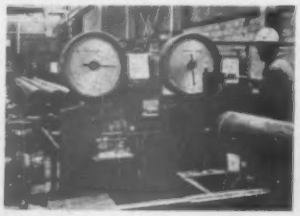
HYDRAULIC FLATTENER

END FACING MACHINES



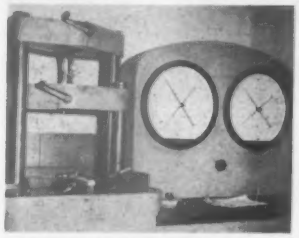
HYDROSTATIC TESTER

FINAL INSPECTION AREA



WEIGHING AREA

LABORATORY CONTROL



MECHANICAL TESTS

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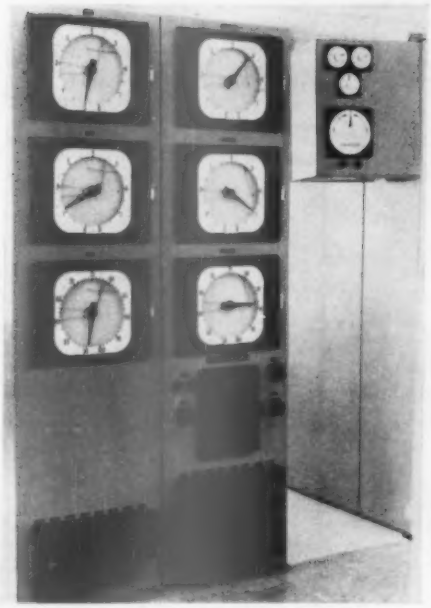
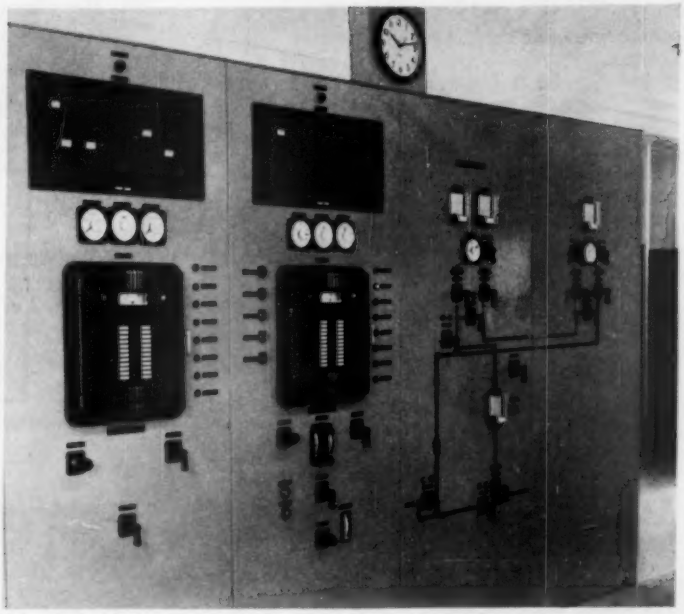
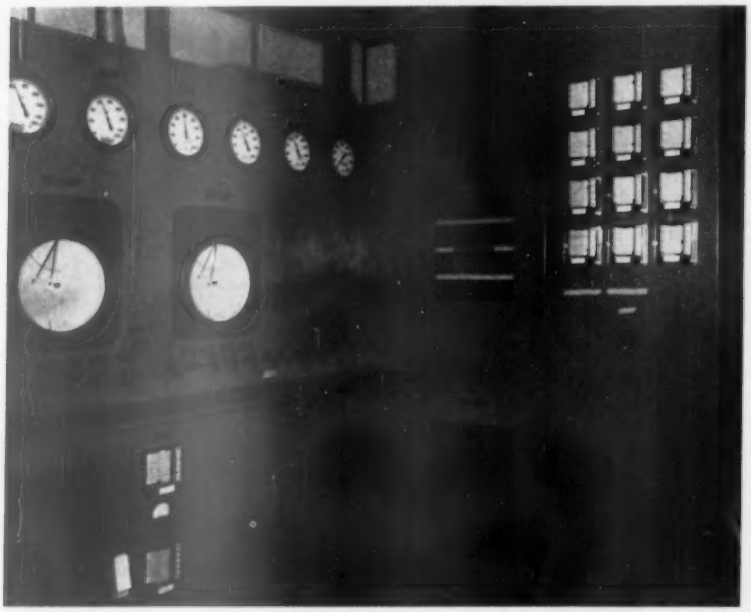


SUPERVISORY EQUIPMENT at remote station, Alexandria, La. Fig. 3.



LOCAL CONTROL PANEL for turbines and station valves with mimic diagram of station piping. Fig. 4.



SUPERVISORY AND TELEMETERING EQUIPMENT at master station in Kinder, La. Fig. 5.

d.c. constant voltage, on-off pulses, which key tone transmitters that have continuous audio-frequency tone outputs and which shift in frequency with each pulse of the tones. The tones are transmitted via microwave to frequency audio-tone receivers at the master station and converted to the original signals received from the telemeter transmitters, are indicated and recorded.

The supervisory equipment is an all-relay code selector type. Included are the following features.

1. An equipment check whereby the master station can initiate both station and point selection checks. With the station check, all indicating light circuits are checked for operation and correct position.

The point-selection check indicates whether the supervisory control equipment is functioning properly both at the remote and master stations, with the point to be checked and selected by the operator at the master station.

2. Changes that occur during outages of transmission channels or tone equipment, are stored and transmitted to the master station when the outage is corrected. If outside interference occurs while a code is being transmitted, supervisory equipment will automatically reset and start the operation again.

3. Supervised units that change automatically at the remote station send a code to the master station. The master station responds by sending a check code to the remote station. The remote station will verify by transmitting the proper code.

4. When two or more automatic changes occur at the same time, they will be transmitted one at a time in order.

5. The remote station will continue to operate in accordance with the last demand from the master station should a malfunction occur such as loss of supervisory circuiting. It will sound an alarm at the remote station so that the units can be operated manually until the supervisory system is corrected.

Control equipment. The supervisory equipment at the remote station is shown in Fig. 3, the master-station equipment with the telemeter-receiving equipment is shown on the right in Fig. 4. The local control panel for the turbines and station valves, and a diagram of the station piping is shown in Fig. 5.

With the aid of this equipment, the

master station operates the remote station provided certain requirements are met. The remote-station schematic piping diagram (Fig. 6) illustrates the station piping system, sequencing of valves, and requirements. For an initial startup, or after an emergency shutdown, the utility man manually purges the yard piping and then pressurizes the lines up to the compressor valves 1S, 1D, 2S and 2D.

With the yard piping pressurized, the control switches "remote-local" for turbines 1 and 2, and the supervisory equipment control switch "remote-local" in the "remote" position, the master station is then in command. Fig. 7 shows how the master station performs and the information from the remote station.

Before starting a unit from the master station, a station check and a point-selection check are made to determine if the equipment is operating satisfactorily, that the control switches are in the remote position, and that the bypass valve "A-BP" is closed and main-line valve 827-1 is open.

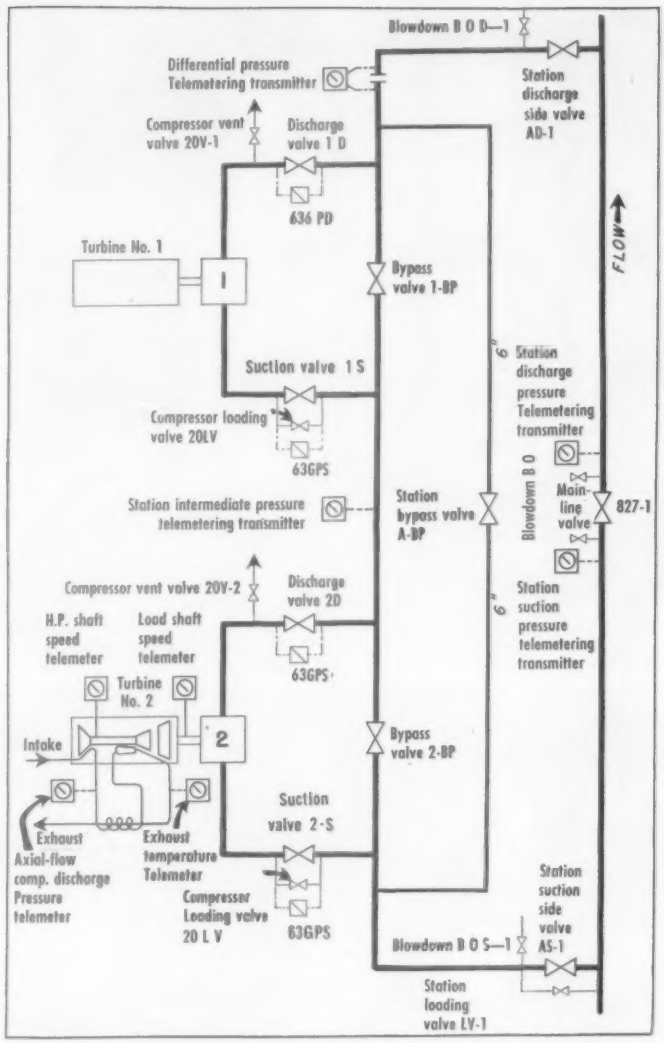
Turbine Starting

The following description arbitrarily starts turbine No. 2 first; however, either turbine may be started first. The operator at the master station selects point "Start Gas Turbine No. 2" by actuating the selector button. A selector code is transmitted to the remote station, checked, and the control circuit selected is connected to supervisory equipment and a duplicate check code transmitted back to the master station.

If the check code agrees with the original, an amber light indicates that the unit is ready to start. The operator then actuates the "start" key transmitting a code to the remote equipment to start the unit.

When this request is received at the remote station, the turbine and associated equipment start through the starting sequence, the amber light at the selected point goes out, and a blue light indicates that the starting sequence is in progress. During the starting sequence the following events occur:

1. Immediately the
   (a) Auxiliary a.c. lube-oil pump starts.
   (b) Turbine nozzle cooling-water a.c. pump starts.
   (c) Turbine cooling-water circulating pump starts.
   (d) Atmospheric cooler fan starts.
2. In sequence
   (a) Compressor seal-oil pump starts when sufficient lube-oil pressure is available. Should main seal-oil pump fail to run or deliver required seal-oil level within 2 minutes, the standby seal-oil pump will start.
   (b) When compressor seal-oil pressure is normal, the loading valve "20LV-2" opens and the compressor case is purged for 2 minutes.
   (c) After the purging cycle is completed, the compressor vent valve "20V-2" closes, and the compressor is pressurized.
   (d) When the case pressure and line pressure equalize, differential pressure switches 63GPS and 63 GPD close, opening suction and discharge valves 2-S and 2-D, and limit switches from the two valves close, opening station discharge side valve "AD-1."



STATION PIPING SYSTEM, sequencing of valves and requirements at remote station. Fig. 6.

When the station discharge valve opens at the remote station, the blue indicating light on select point "Start Turbine No. 2" at the master station goes out and a flashing green light comes on, sounding an alarm which is silenced by the operator, and the green light burns steadily.

This indicates that all associated equipment and station valves are in correct position and that the turbine is starting. The turbine goes through a sequence up to idle speed during which time the following occurs:

1. The starting turbine clutch engages the turbine.
2. Starting turbine starts.
3. Turbine is purged.
4. Turbine fires.
5. Turbine goes through a warmup cycle.
6. Turbine up to idle speed.
7. Red "Complete Starting Se-

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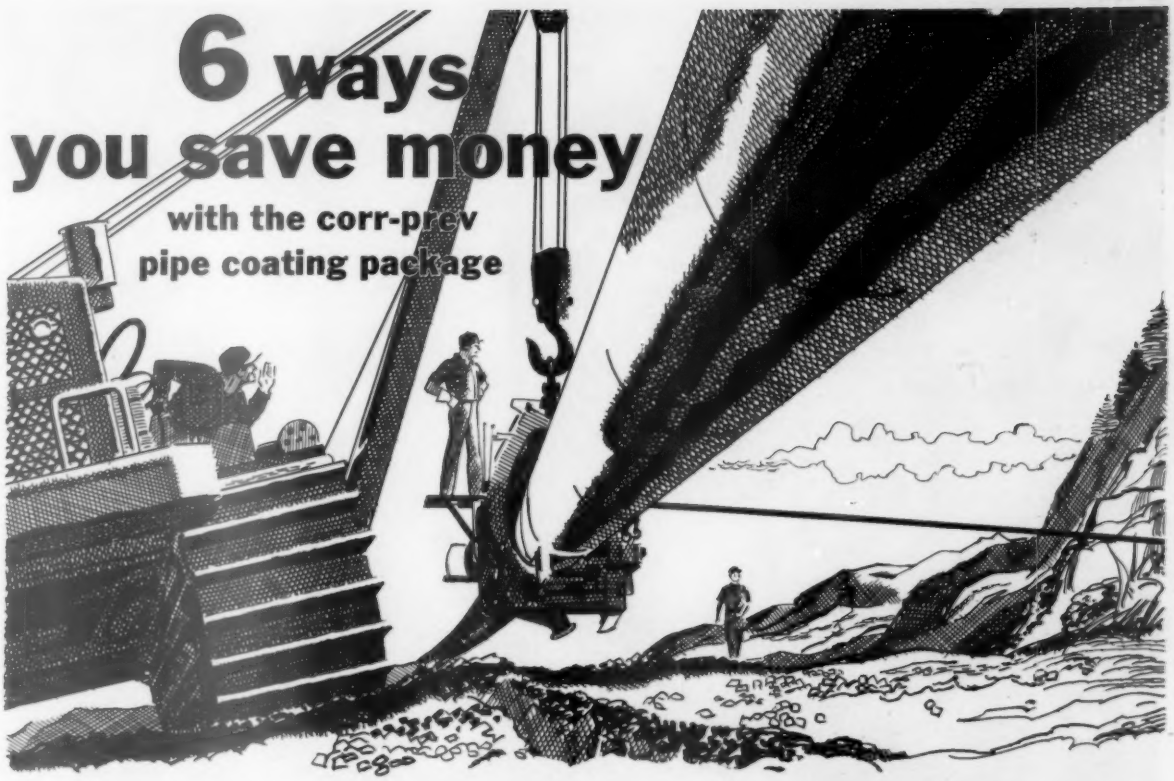

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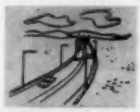

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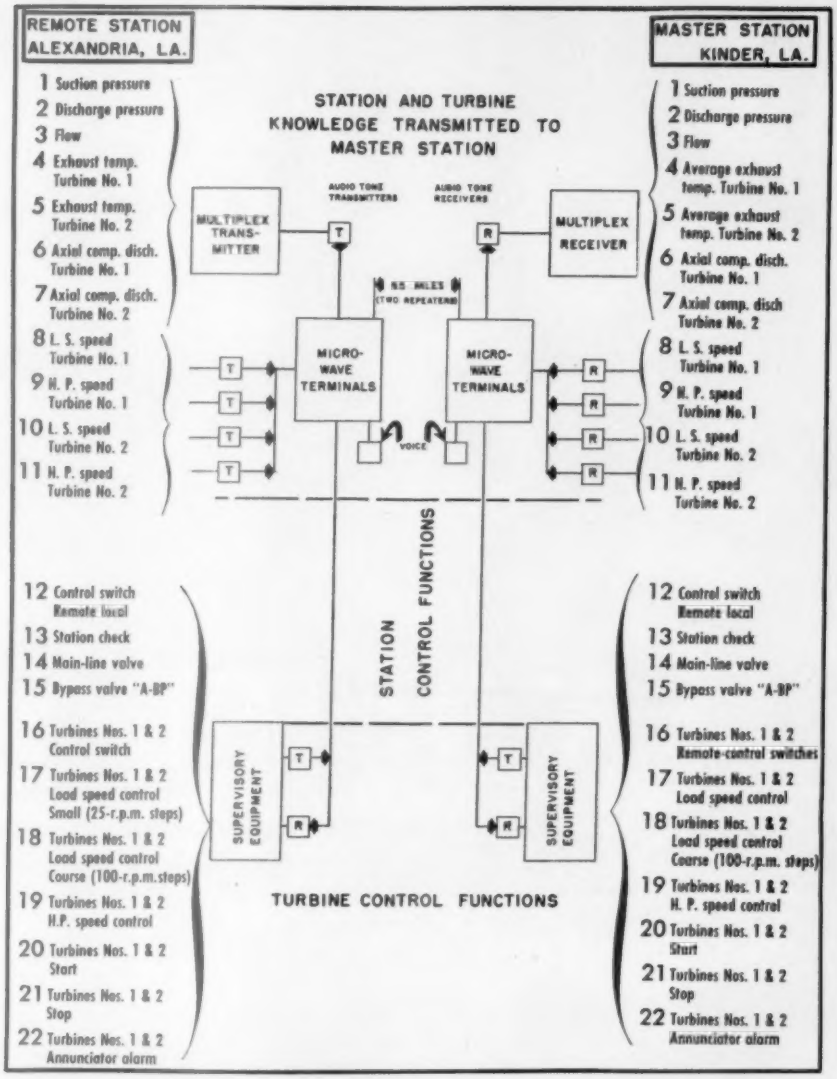
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7 Axial comp. disch. Turbine No. 2
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11 H. P. speed Turbine No. 2
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MULTIPLEX TRANS-MITTER
MULTIPLEX RECEIVER
T
R
55 MILES (TWO REPEATERS)
MICRO-WAVE TERMINALS
MICRO-WAVE TERMINALS
VOICE
STATION CONTROL FUNCTIONS
12 Control switch Remote local
13 Station check
14 Main-line valve
15 Bypass valve "A-BP"
16 Turbines Nos. 1 & 2 Control switch
17 Turbines Nos. 1 & 2 Load speed control Small (25-r.p.m. steps)
18 Turbines Nos. 1 & 2 Load speed control Course (100-r.p.m. steps)
19 Turbines Nos. 1 & 2 H.P. speed control
20 Turbines Nos. 1 & 2 Start
21 Turbines Nos. 1 & 2 Stop
22 Turbines Nos. 1 & 2 Annunciator alarm
SUPERVISORY EQUIPMENT
SUPERVISORY EQUIPMENT
TURBINE CONTROL FUNCTIONS
16 Turbines Nos. 1 & 2 Remote-control switches
17 Turbines Nos. 1 & 2 Load speed control
18 Turbines Nos. 1 & 2 Load speed control Course (100-r.p.m. steps)
19 Turbines Nos. 1 & 2 H. P. speed control
20 Turbines Nos. 1 & 2 Start
21 Turbines Nos. 1 & 2 Stop
22 Turbines Nos. 1 & 2 Annunciator alarm

MASTER-STATION FUNCTIONS and information received from remote station. Fig. 7.

quence" light burns at remote station.

8. Bypass valve "2-BP" closes.

When the turbine has completed its sequence and is at idle speed the green light on point "Stop Turbine No. 2" at the master station goes out and the red light flashes, sounding an alarm which is silenced by the operator, and the red light burns steadily. This indicates that the turbine has completed its sequence and that the operator is in control of the unit on a selective basis.

Starting turbine. The starting of turbine No. 1 follows the same pattern. When the second unit has completed its sequence, the operator at the master station is then ready to load the station by closing the station M.L.V. 827-1, and increasing the load turbine speeds slowly and simultaneously until the ordered discharge pressure is reached.

If a malfunction should occur while operating the two units and either one goes down, the following will take place immediately and automatically:

1. An alarm sounds at both the remote and master station and shows on the annunciator at the remote station.

2. The station discharge valve "AD-1" closes.

3. Bypass valves "2-BP" and "1-BP" open.

4. The turbine that did not experience difficulty returns to idle speed, and the speed-control circuit is sealed in the idle speed position.

When the alarm sounded and alerted both the remote and master stations, the utility man at the former immediately goes to the control room to determine the cause of the shutdown. The operator returns to his position to watch the conditions at the remote station, checking both suction and discharge pressure. When the suction and discharge pressures across the station are equalized, main-line valve 827-1 is opened by the operator. Should the operator fail to open the valve, the utility man at the master station, who also has control of the main-line valve, will open it.

When the main-line valve is fully open the following events are automatic:

1. Indication at the remote and master stations that the valve is open.

2. The station discharge side valve "AD-1" will open.

3. The bypass valve for the idling turbine will close.

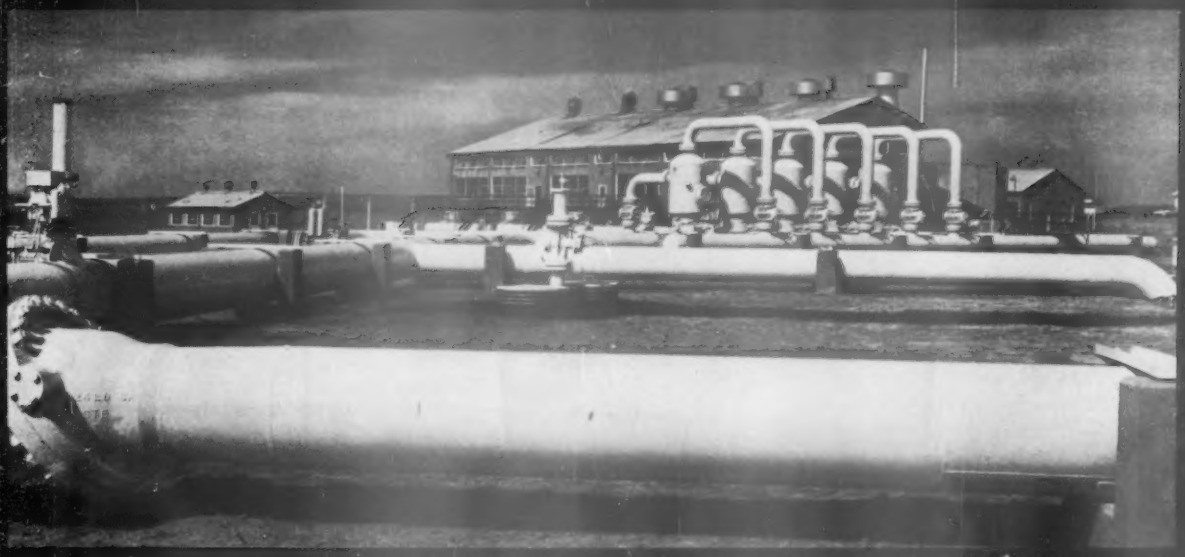
4. The seal around the speed circuits for the idling turbine's load shaft is released, the turbine remains at idle speed, and allows the operator at the master station to place the unit on the line by closing the main-line valve 827-1, and increasing the load shaft speed.

Preventive maintenance. A preventive - maintenance program is necessary to assure reliability and availability of the units. This requires periodic inspection of limit switches, pressure switches, relay, and sequencing devices. A continual study has been conducted to obtain the most reliable devices for better operation of the remote station and reduction of maintenance.

Simplicity of control of the turbines lends itself well to remote-control operations. This system is the simplest type of remote control and is very economical. The initial installation represented the greatest financial expenditure. With the addition of the second unit the over-all economy was improved and as the station continues to expand the economics will continue to improve. Reduction in operating cost through the remote system is evident. It has been reliable and the availability has been excellent.

The experience and knowledge gained in operating this turbine station and numerous meter stations throughout the Tennessee Gas System has aided in the design of a computer-controlled reciprocating station which will be placed in service late this year.

THREE GENERAL ELECTRIC GAS TURBINES *in this petro-chemical plant run continuously, demonstrating General Electric gas turbine reliability.*



OVER FIVE YEARS OF DEPENDABLE OPERATION – and still going strong. The record of the four units in this gas pipeline compressor station underscores the high availability–reliability characteristics of General Electric gas turbines, including 200 installed units.

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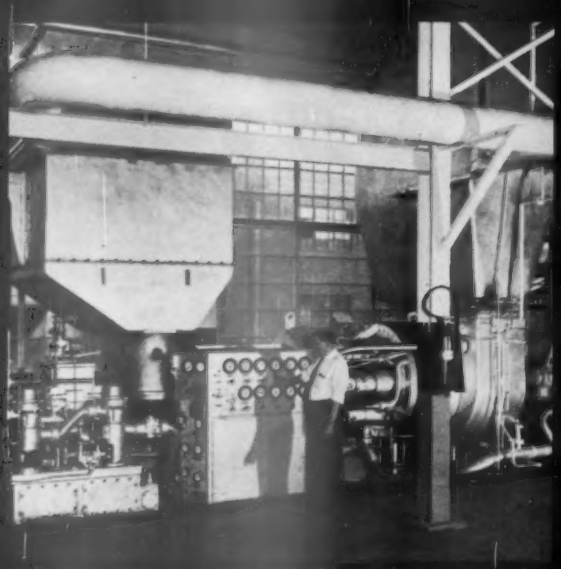
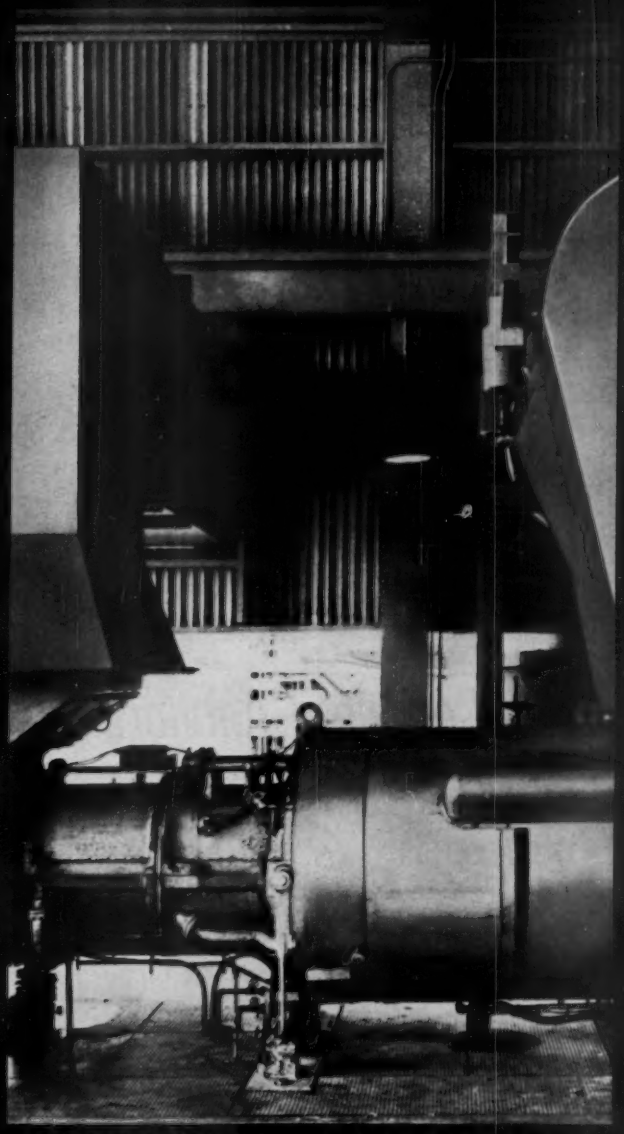
ON THE ARABIAN DESERT, six unattended pipeline pumping stations powered by reliable General Electric gas turbines are being radio-controlled from fifty to one hundred miles away.



THIS DUAL-FUELED UNIT is providing dependable generating capacity and at the same time further contributing to plant efficiency by exhaust heat recovery for steam generation.



IN A PROCESS CHEMICAL PLANT, this G-E gas turbine operated continuously for 13,178 hours, or 18 months, before maintenance of process equipment dictated shutdown. It now has a total of 56,000 hours' operation.

Reliability—the vital product feature on the pipeline and in the process plant—is assured from the performance record achieved by the 200 General Electric gas turbines now in service. Evaluate these facts against your requirements:

- 132 G-E gas turbines are now serving industrial users—87 units are on pipelines, 27 units are driving process compressors, and 18 units are in industrial power generation service—with nearly 3,000,000 operating hours;
- a study of all General Electric gas turbines in high-use-factor service (50 units) reveals an average of 98% availability and 99.5% reliability, with many having been in service since the early 1950's; and
- ten units are now in service with over 50,000 hours of operation, 35 units with over 40,000 hours, and 64 units with over 30,000 operating hours.

And, these remarkable records have been set under some of the most severe operating conditions—a few of which are shown in these illustrations.

Reliable General Electric gas turbines—available in a wide range of sizes—are the *economical* answer to your process and pipeline power needs.

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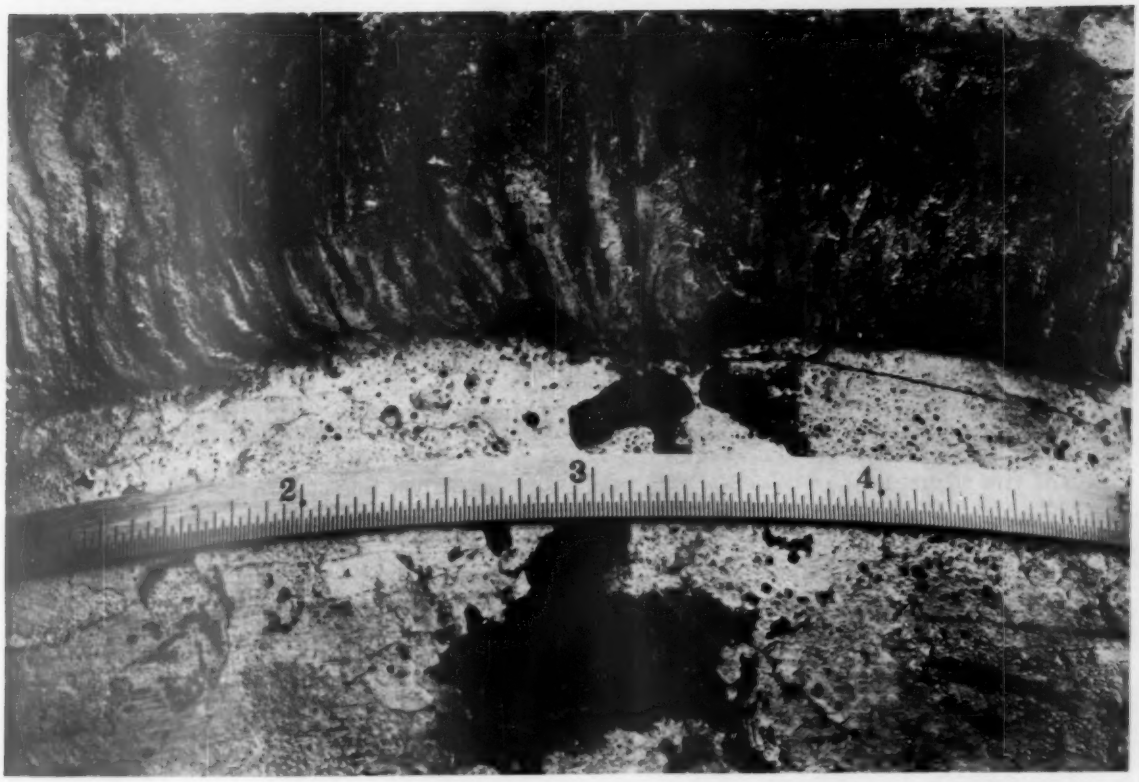


VIBRATION FATIGUE CRACK caused by weld undercut. Pipelines are continually being subject to cyclic stressing. Fig. 1.

A pipeliner answers the question:

What are future pipeline needs?

NEEDS for future line pipe are, in summary:

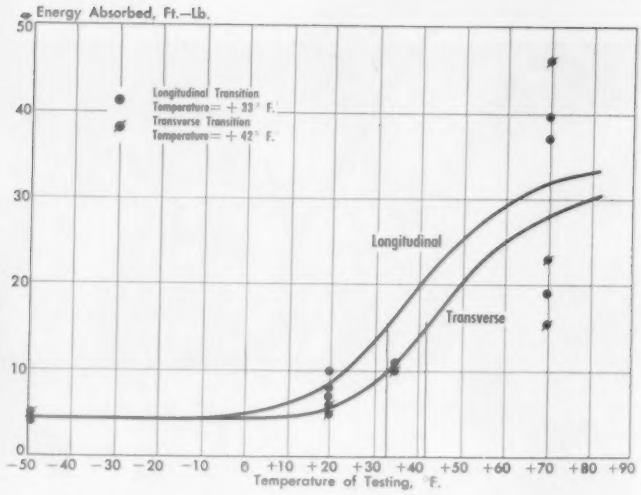
- Most important is improved weldability in the range of conditions encountered in pipeline construction.
- High-strength steels for large-diameter, thin-wall pipe, without loss in ductility.
- Lower transition temperature and elimination of cleavage-type ruptures is becoming increasingly more important.
- Notch insensitivity is property that must be developed.
- Better control of chemical and physical composition must be provided. This can be achieved now by nondestructive testing and other means.
- Pipe of closer tolerances must be produced, both at the ends and in the middle. Cutting to remove defects must be limited because high percentages of short lengths mean increased construction costs.
- Improvement of visual inspection in the pipe mill, at the unloading sites, and in the field will reduce trouble and failure in the completed line.
- Correlations of field experiences with laboratory and mill tests must be developed, and new test methods are needed.

About the author...

A. G. BARKOW, superintendent of inspection department, Natural Gas Pipeline Company of America, was engaged early in his career in the laboratories of A. O. Smith Corporation. Later he was metallurgical and welding staff engineer with Maryland Casualty Co.'s boiler and pressure vessel division, before starting 20 years of service with his present company.

Higher strength. The increasing demands of the market for more petroleum products and natural gas dictates the use of larger pipe diameters and greater transmission pressures. To meet these demands the industry will need pipe of greater wall thickness with present steels or pipe made of steel having greater strength. Greater strength can be achieved by chemis-

CLEAVAGE TYPE FAILURE is typical when line pipe fails under field pressure, even though the material is normally ductile. Fig. 2.



TRANSITION TEMPERATURE is point when nature of fracture changes from predominantly cleavage to predominately shear. Fig. 3.

try, by cold working, by normalizing or quenching, and tempering. However, increased strength must be achieved without detrimental effects to other properties which are just as important.

Benefits achieved by cold working of steel and by use of higher chemistry as we find it in present-day pipe have been gained at the expense of ductility. Internal loading and superimposed external loading are constantly subjecting pipelines to more and more cyclic stressing (Fig. 1). Field bending during the laying process and the laying of lines through tortuous country, as well as the movement of pipe after it has been laid emphasize the need of greater ductility.

Lower Transition Temperatures

Most failures of line pipe under field pressure, both during testing and operation, have been of a brittle nature; that is, the pipe material has exhibited a cleavage-type fracture even though the material is normally ductile (Fig. 2). Many of these failures have occurred at ambient temperatures of 50° to 70° F. It has been established that cleavage fractures usually occur in materials below the so-called "transition temperature." It also has been established that cleavage-type fracture rate of propagation may be as high as 6,000 ft. per second.

On the other hand, energy dissipation of gas in a pipeline is equal to the rate of sound or about 1,300 ft. per second. Therefore, a failure whose crack propagation is greater than 1,300 ft. per second may travel endlessly unless a so-called "crack stopper" is encountered. This may be a valve or fitting, a sharp bend in the pipe, a poor girth weld, or a length of pipe whose transition temperature is high enough to change the nature of the crack to shear.

The shear-type crack propagation is known to be relatively slow, thus permitting the energy to be expanded more rapidly than the crack propagation. Transition temperatures are determined by use of a series of impact tests at various temperature levels. The temperature at which energy absorption materially increases or at which the nature of the fracture changes from predominantly cleavage to predominantly shear is referred to as the transition temperature of the material (Fig. 3).

Present high-strength steels of pipeline quality have transition temperatures from 30° F. to over 100° F. Transition temperatures can be controlled by chemistry, alloying, or heat treatment. Since pipelines are reaching the colder climates and since producing fields have been discovered in Canada and the northern states, it becomes more and more important that pipeline steels be developed that have transition temperatures of around −20° to −50° F.

Notch sensitivity. Notches are the bane of pipeline steels. They are the stress raisers that provide the starting points of a pipeline failure. Notches may be mechanical or metallurgical. Regardless of the care and inspection that a pipe may receive, nicks, scratches, weld defects, and surface abrasions do occur. Even the smallest notch or arc burn may be the cause of a failure if other conditions are right.

Steels that have a tendency to be readily affected more termed notch sensitive. Codes and standards recognize this fact and specifically regulate the sizes of notches allowed. However, this is not the best answer to the problem. The important goal in pipeline steels is the development of a steel which is insensitive to notches.

TABLE 1—TYPICAL ACTUAL CHEMICAL AND PHYSICAL PROPERTIES, API STD. 5L AND 5LX PIPE

Size (in.)	Gr.	% Carbon	% Manganese	Yield, 1,000 psi.	Ult. 1,000 psi.	% Elong.	Type
12¾ by 0.500	A	0.06-0.20	0.30-0.59	42-48	49-62	41-48	EW
12¾ by 0.250	B	0.17-0.26	0.45-0.66	52-61	61-74	36-43	EW
12¾ by 0.281	X42	0.20-0.26	0.61-0.80	43-50	62-72	32-42	EW
20 by 0.312	X42	0.21-0.32	0.68-1.19	50-64	65-85	30-50	EW
16 by 0.250	X46	0.20-0.28	0.55-0.72	52-61	73-81	29-32	EW
20 by 0.250	X52	0.23-0.30	1.04-1.23	57-65	74-85	32-40	EW
30 by 0.344	X52	0.26-0.31	0.96-1.09	55-65	80-94	26-30	EW
36 by 0.438	X52	0.22-0.29	0.87-1.18	55-63	73-84	30-36	EW
Specified	A	0.22 max.	0.95 max.	30 min.	48 min.	35	EW
	B	0.27 max.	1.35 max.	35 min.	60 min.	30	EW
	X42	0.28 max.	1.25 max.	42 min.	60 min.	25	EW
	X46	0.28 max.	1.25 max.	46 min.	63 min.	23	EW
	X52	0.28 max.	1.25 max.	52 min.	72 min.	22	EW

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INTERNAL X-RAY EQUIPMENT is one type of nondestructive testing apparatus used for inspection of line pipe. Fig. 4.

Weldability. With all the physical properties that are demanded for safe and economical operation of high-pressure pipelines, the steel must still be weldable under a wide range of field conditions. Steels are available which will meet the needs of the pipeline industry. But they require special care, special weld rod, and welding procedures which are uneconomical, impractical, and frequently impossible to follow in field welding. As a matter of fact, the steels now used approach the practical limit of field weldability and do require preheating during low-temperature construction periods.

Carbon and manganese are limiting elements for weldability as it is known to the pipeline industry. Investigations made on the effect of carbon and manganese indicate that higher levels might be used. Other elements can also be used to improve steel physical properties and at the same time improve weldability. It always must be remembered that welding is the largest single cost factor in the construction of a pipeline.

Chemical alloying of steel to increase physical properties while retaining weldability appears to be the prime avenue to success in this field. A number of alloying elements when added in very small quantities will produce remarkable results without affecting the economic balance now used.

Carbon - manganese. Carbon and manganese are the principal elements of present pipeline steels affecting physical properties. Carbon produces both strength and hardness in steel. Manganese adds to the strength but also increases toughness.

Normally the manganese - carbon ratio is held to 4:1, with a carbon maximum of 0.28% and manganese maximum of 1.25% for plate-welded pipe and slightly higher for seamless pipe. Experimental work in ship failures show that a manganese-carbon ratio of 6:1 might be more suitable since the desired strength can be maintained, while at the same time the toughness and weldability can be improved. There has been some effort to raise the maximum manganese-carbon level slightly to obtain higher-strength line pipe, but this move is still somewhat questionable and has not been fully accepted by the industry.

Alloying elements. The alloying elements that have received most favorable attention for pipeline steels are molybdenum, columbium, titanium, and vanadium. All of these elements have one factor in common—they are strong ferrite formers and thus increase hardening ability. Addition of relatively small amounts of these elements will increase the yield strength of steel, even with a reduction of carbon. Thus, steel properties can be achieved that are higher than present pipeline steels, with greater toughness, lower transition temperatures, and improved welding qualities.

Investigations also have been made into the so-called "low alloy—high strength" steels containing varying amounts of nickel, chromium, molybdenum, vanadium, copper, and boron. Significantly higher strength can be achieved by use of such steel compositions. Pipeline steels of 80,000 to 100,000-psi. minimum yield may be achieved.

PIPE SHIFTING in car during shipment can cause vibration fatigue and subsequent failure under test. Fig. 5.

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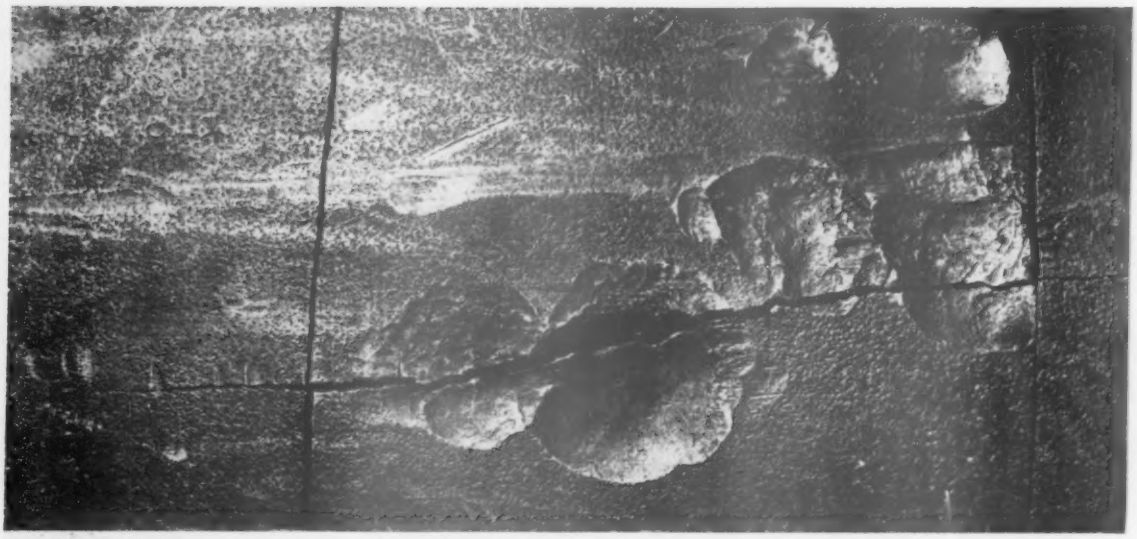

PIPE WELD DAMAGE was caused by rivet in side of car during shipment. Work hardening caused crack. Fig. 6.

While all of these steels can be looked upon with favor, the problem of weldability under all field conditions is receiving major interest. Some of these steels are commercially available and have been established as weldable under shop conditions, but are still being investigated for field work.

Residual elements. Probably as important to the improvement of pipeline steels as the addition of alloying elements, is the control of "tramp" or residual elements. Since scrap comprises as much as 50% of a heat of steel, the residual or noncontrolled elements inherent in scrap must be closely watched. Frequently an analysis of pipeline steels will show amounts of certain residuals which approach the low-alloy classification.

This is undesirable since it not only complicates the welding problem but can introduce undesirable physical and metallurgical problems. Total tramp elements may exceed 1.5%.

Control. Possibly the most urgent demand made on steel mills and pipe manufacturers is for more rigid control of steel composition, physical properties, manufacturing process, welding, and inspection. The severe conditions under which pipelines work and the populated areas through which they pass demand the utmost in safety, and safety depends on obtaining to a full measure the properties that are designed into a structure.

A good design is based on a balance of the necessary properties, which means that an excess in one property, such as strength, is not always most desirable because of the adverse effect on ductility. Next to quality, control is the most important attribute in the production of line pipe.

Control of the important elements, such as carbon and manganese, within a range narrower than is now the practice would be most beneficial in production of pipe of uniform strength and weldability. The specified ranges now give only a maximum percentage of these elements and this maximum is practically the same for all grades of pipe. This being true, it is possible to order a relatively low-strength, ductile product and receive the same material that is used for the much higher-strength grades, as shown in Table 1. Thus the designer does not have the properties he designed into the fabrication. A real need exists for a review of line-pipe chemistry.

Physical treatment. Pipeline steels may be improved through physical treatment, as a function of the rolling process or through cold working, either expansion or compression. Better physical properties may be achieved in the plate by variation in the rolling and finishing temperature. Surface properties may also be improved by controlled rolling temperatures. Cold working, the most common of which is internal expansion, will increase the transverse yield strength by as much as 12,000 psi. and the ultimate strength by 3,000-4,000 psi., but does reduce the ductility (as measured by elongation) by about 25%.

Cold working also has an adverse effect on the transition temperature and increases notch sensitivity. These results are achieved by stretching the steel by approximately 1.5%. Within the limits of the API Standard, such cold working has a definite economic advantage, and this amount of cold work does not change other properties dangerously. Undoubtedly greater improvement by these methods may be expected with increased control of rolling practices. Recent improvements in rolling and finishing include the application of electronic control devices in the rolling and finishing of the plate.

Heat treatment. Heat treatment of pipe is not really new since it has been successfully used for steel casing in the oil industry. The preferred heat treatment is the quench-and-temper method. Experimental pipe has been made by this method having yield strength of around 100,000 psi. Another heat treatment which offers distinct possibilities for steel is the normalizing treatment which produces a fine-grain structure and uniform properties as well as a desirable increase in toughness.

The heat treatment of line pipe, in the quantities and speed of production required, presents a number of problems which are being solved by producer laboratories.

Physical control. Hinging partially on chemistry and partly on steel-making and rolling processes are the physical properties of line-pipe steels. The important properties are yield and ultimate strength, ductility, impact, and notch insensitivity. Most of these properties compliment or influence one another—a rise in yield strength by mechanical working will lower ductility and increase notch sensitivity, for instance.

An increase in yield strength also will increase the yield-tensile ratio, since the ultimate is not as respon-

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sive to cold work, as the yield point. To obtain the best relation between physical properties for design application, a property such as ductility or impact value may be more necessary than excessive strength.

The range of physical properties is usually specified as a minimum value which again permits production of high-strength pipe complying with much lower minimum standards. This defeats the designer's purpose for pipe selection. Control of physical properties needs some study to establish both minimum and maximum limits within reasonable expectation of the user.

Classification. Specifications written by ASTM and API establish a whole series of pipe classifications, all of which are open-end; i.e., pipe under one standard can meet the requirements of classifications both above and below the particular grade. Control is vitally necessary to separate the grades into their proper classification. It is reasonable to expect that one grade will overlap the lower end of the next higher grade, but it is not reasonable to expect acceptance of pipe that overlaps three or four higher grades.

It is not infrequently found that the actual yield point exceeds the specified minimum ultimate and that the ultimate is 50% higher than specified. By the same token the ductility approaches the minimum specified and notch sensitivity reaches a danger point. Ductility and notch sensitivity cannot be sacrificed for strength and hardness where operations may cause cyclic fatigue failures.

Nondestructive testing. Possibly one of the outstanding demands made by the users of line pipe has been the adoption of some type of nondestructive test method for quality control and as a defect-limiting device. Most of the pipe mills are using nondestructive testing to a limited degree and some have made sufficient progress in their adoption of a method to apply it to total production. However, there still is no agreement on the allowable limits of defect size—and on the methods and interpretation of indications—to permit adoption by code.

These devices are used for manufacturing-quality control purposes only and results have not been made available to the user as a basis of acceptance. The rapid advances made in pipe-laying technology and the requirement of nondestructive methods of testing field welds make it almost mandatory that the user have some control of acceptability by these devices in the pipe mill.

Nondestructive testing methods being used by the pipe mills include radiography (Fig. 4), fluoroscopy, magnetic particle, eddy current, and supersonic methods. One of the major problems of the adoption of nondestructive testing to pipe fabrication is the fact that no one method can be used on all types of pipe fabrication. Another deterrent is the lack of acceptable standards and reproducible results. The final deterrent is the time factor for such inspection and its adoption into the production line.

With the great amount of experimental work being done in this field and the urgency of the users' demands for such testing, it is gratifying to note that the goal is being achieved and that we may soon see nondestructive testing adopted on all high-pressure pipelines. Technical advances made in the equipment as well as agreements reached on acceptable interpretations and limits will help attain the desired results.

One of the age-old problems of pipe fabrication hinges on the question

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"How round is round?" Tolerance standards have been adopted. However, these tolerances are not applicable to present large-diameter, thin-wall pipe. While the field has lineup clamps of various types, they are not designed to round out or expand pipe ends to uniform size. The reduction of wall thickness makes it imperative that the welding edges butt together without offset and that matching pipe ends be exactly the same size.

Moreover, the fact that pipe frequently must be cut to length brings with it a demand that pipe size be uniform throughout its length. Specifications, as now written, permit missmatch of the pipe in the body to a point where one pipe will fit into the end of the next pipe without violating the tolerance limits of the standard. This, of course, causes great hardship and loss of time and money to the user and laying contractor. Closer tolerances at the ends and in the body of the pipe are subjects that must be given immediate attention.

Limit on cutting. Cutting to remove defects reduces the length of the pipe, necessitating more field welding and an increase of welding and inspection cost. Shop welding of short lengths of pipe is seldom permitted because of the stringent welding control used in the field and the impossibility of maintaining such control in a shop. While it is uneconomical and undesirable to reject good pipe because of length limitations, it is likewise uneconomical to accept large amounts of such short lengths.

The standards prescribe the acceptable minimum length limits and allowable percentage of such "shorts." While this is reasonable to a limited extent, the minimum allowable length is such that it would require two welds to make a standard length. It is believed that the minimum prescribed length should not be less than 50% of the specified length and no more than one weld should be allowed per standard length of pipe.

Wall thickness. With pipelines operating at 72% of minimum specific yield strength and with an allowable reduction of wall thickness of 10-12½%, we find that it is possible actually to operate at 80% of minimum yield strength. Under present working conditions, this high working stress on a small section of pipe may be the cause of failure. Since the standards also permit defects of similar depth, this danger is multiplied by the fact that many defects are in themselves stress concentrators and, where such a stress concentration is coincidental with a thinning of the wall, the incidence of a failure is present.

With present control, is it necessary to allow a minus tolerance on basic wall thickness and if so, is it reasonable to design to a nominal wall thickness? This question has caused a great deal of discussion and arbitration in the past and is still vital to the users. An increase of 10-12½% to wall thickness in design calculation would be a great financial burden to the user. This is especially true in the use of large-diameter, thin-wall pipe.

Repair size. Size of allowable repairs made to the body of the pipe by welding is still another problem confronting the users. Conditions may be such that the repair of a defect by welding can cause greater stress concentration than the original defect. Added to this is the fact that it is difficult to make a clean homogeneous weld in the plate so as to fill in a depression. Since it is practically impossible to remove the stresses by stress-releasing heat treatment, the danger of a depression has been replaced by the danger of a metallurgically induced failure.

Rewelding of defective areas in the longitudinal seam adds to the possibility of induced failure even though such repaired pipe is retested. Quality of workmanship in such welded repairs is often questioned. Because of the possible existence of weak points

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created by defects, it is quite generally the practice of the pipe mill to cut out the defective section. Defects found by the laying contractor and caused either by shipping, handling in the field, or accidental contact by tractors or other equipment, and defects that originated in the pipe mill are, as a rule, cut out and rejected. Repair welding in the field to the body of the pipe is not permitted.

Inspection. Inspection of each length of pipe for weld and surface defects, both inside and outside, is vitally important. Inspectors must be trained for this work and, preferably, should have had a background of pipe-mill experience. In this, most pipe mills have a very strong organization, and inspection is provided throughout the manufacturing process. A final inspection also is made by an outside agency before the pipe is accepted and shipped.

Inspectors must be continually alerted to the need of sharp visual examination. Inspection agencies must offer a genuine inspection service performed by men who are thoroughly familiar with their work and will conscientiously perform their assignments. This inspection should not be considered a mere matter of form that can be done by anyone available on a moment's notice. While the mill inspectors find the greater number of defects and have them repaired before the pipe is presented for final inspection, it is the responsibility of the final inspection to clean out every last defect that may be present.

Pipe also should be inspected upon arrival at the unloading destination to determine damage which may have been sustained during shipment and, lastly, before the final coating to discover any gouges or damage sustained during the laying operation. Actually, all field personnel should be alerted to keep constant watch for pipe-wall damage. An outstanding point of inspection is after the pipe has been primed and before it is coated. The primer highlights all surface damage so that it may be readily found.

Defect control. Defects of line pipe fall into three categories—steel defects, manufacturing defects and field defects. Steel defects include scabs, slivers, blisters, laminations, pits and others. The occurrence of any such defects must be brought to the attention of the producing steel mill immediately so that the necessary control may be exercised.

Manufacturing defects include gouges, scratches, dents, weld defects, offset seams, poor bevels, and others. The inspector must note occurrence of such defects and check with mill operations immediately.

Field damage must be held to an absolute minimum and this can readily be accomplished by alert inspectors. Shipping damage should be reported to the mill immediately so that changes in car-loading practices can be made.

Surface damage and detrimental defects cannot be tolerated, even to an extremely minor degree of occurrence, since one defect may initiate failure of extended length.

With all the tests and inspection that have gone into pipe manufacture in the past, the user has had numerous experiences of failure caused by defects which were present when the line was laid. Most of these failures have occurred during the test period and at pressures which were frequently less than the design working pressure or the mill test pressure. Not only is the industry interested in the cause of failure but also in the type and magnitude of the rupture.

There are undoubtedly many factors besides mill inspection and metal properties that enter into the total picture of field failures. Cold working of the pipe by vibration during shipment, by handling in unloading

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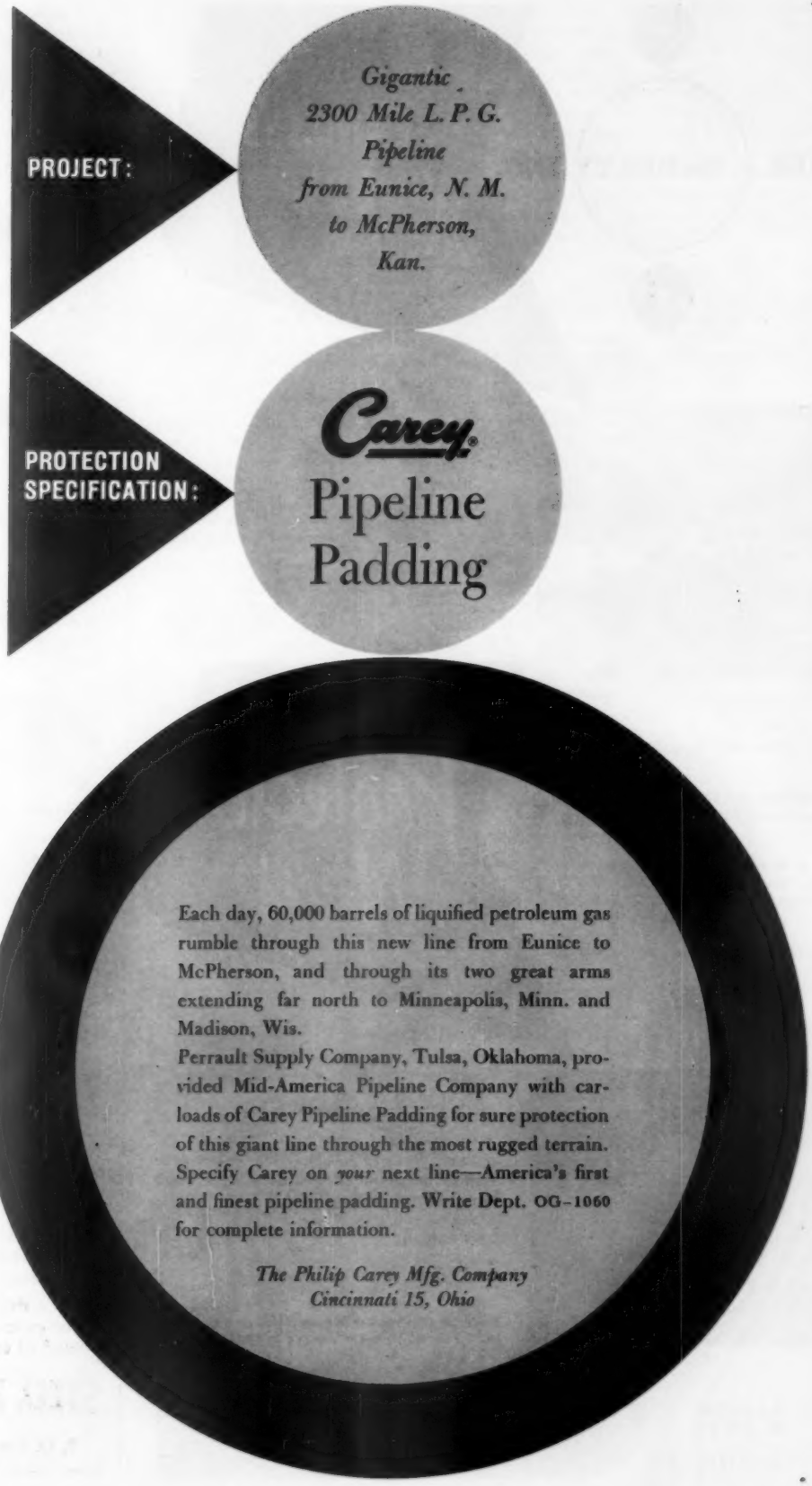
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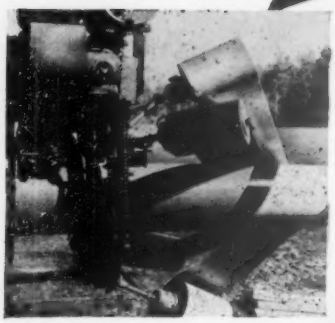

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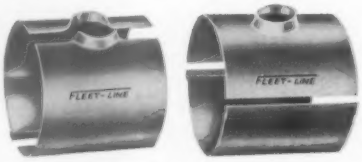

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and stringing along the right-of-way, by welding, and by cold bending is of deep concern. Variation in strength over a wide range also is a factor since the hardness of adjacent joints may be vastly different, thus transmitting stresses unevenly. Variation in chemistry and weldability are other factors which affect the behavior of line pipe in the field.

The fact remains that failures do occur during field testing and operation. Some of the failures have caused great lengths of pipe destruction. While the point of origin can be readily discovered, the length of failure, the total destruction of the pipe, the type of rupture and reason for the type of rupture, and the ending of the rupture are somewhat harder to explain and are therefore receiving a great deal of attention and study.

Methods of recognizing possible weaknesses and unfavorable conditions before failure occurs and even before the pipe is laid are being developed by the various pipe mills. Discovery of weaknesses must be in the form of tests with predictable results.

New Tests and Analyses

There is a general demand that all pipe produced by a mill be tested by nondestructive methods. This is particularly true of the longitudinally welded seam. However, methods are now being developed which can examine the plate surface, both inside and outside, and the weld simultaneously. Success of these methods will eliminate some visual inspection and also will greatly reduce the incidence of defects found in the field and the possibility of actual failures.

Notch sensitivity and rate if crack propagation are factors being seriously studied. The rate of crack propagation, associated with transition temperature, is most readily determined by a series of impact tests. Since this factor is so important and since the temperature below which a high rate of crack propagation can be expected is of deep concern, a way to determine transition temperatures as a physical property is one of the prime needs of the industry.

Some mills are making such tests at frequent intervals as mill-control tests, but results are not made available to the user. Users are aware of the need for such information and have made repeated requests to have such a test written into the specification as a requirement of quality. Since this information is not entirely infallible, the search for a better method of determination of these properties is being continued with increasing vigor.

Vibration fatigue during shipment of large-diameter, thin-wall pipe is receiving attention because failures of pipe under test pressure in several instances have shown the possibility of such occurrences (Figs. 5 and 6). The industry, then, should set up guards against the use of pipe so damaged. Nondestructive spot checks are being made to discover the extent of such damage. Reliable, rapid methods of inspection for such failures are needed.

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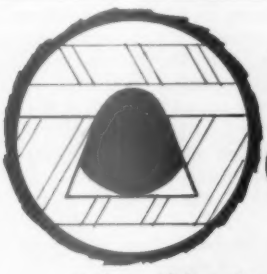

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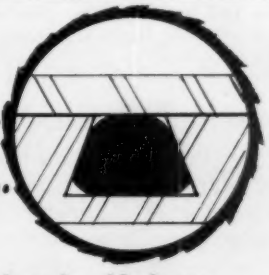

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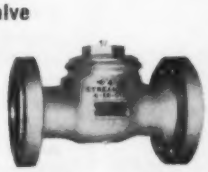

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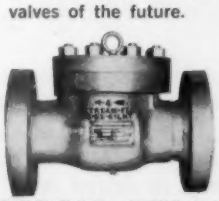

CHARLES WHEATLEY CO., 414 SOUTH DETROIT, TULSA 20, OKLAHOMA

Updating activities will be completed soon for the Bayou Pipe Line System

BY T. S. LLEWELLYN
Senior Engineer,
Service Pipe Line Co., Tulsa

WHEN the modernization program of the Bayou Pipe Line System is completed early in 1961, the intermediate stations will be operated without attendance. Two maintenance technicians will maintain equipment at the relay stations and the manual operations will be reduced to a minimum at the terminals.

The Bayou Pipe Line System has the distinction of being the first undivided-interest pipeline in the industry. It traverses 250 miles of bayou country between Baytown, Tex., and Baton Rouge, and is a major source of refined products for Plantation Pipe Line. The system began operation over 17 years ago and, while adequate for its time and even now, it may be considered old because it was built from second-hand pipe and equipment gathered together by its participating owners during the war emergency.

Operations. Products include house-brand and premium gasolines, fuel oils, kerosine, and naphtha. The gasolines and fuel oils are batched according to grade and shipper's brand. Fuel oil and naphtha are pumped on a closed-system basis from refinery storage to destination. Working tankage of the system is limited and used only for gasolines and kerosine. Some refineries deliver these products direct from storage to the suction of pumps at Baytown and Port Neches because of inadequate tank space.

Tenders are mostly handled as segregated batches to the eastern terminus of the line. Transit time for batches is 2 to 3 days. Three to five batches may be in the system at one time. The movements are scheduled weeks in advance to coincide with anticipated operations of the Plantation Pipe Line.

Facilities. The original system consisted of 68 miles of single 8-in. line between the Baytown terminal and Port Neches terminal near Beaumont, 185 miles of single 10-in. line between Port Neches and the Baton Rouge terminal, 51 miles of 4, 6, and 8-in. feeder lines from the refineries, and 11 pumping stations.

The 8-in. line and three pumping stations between Baytown and Port Neches had a capacity of 43,000 bbl. per day and the 10-in. line and eight pumping stations between Port Neches and Baton Rouge had a capacity of 64,000 bbl. per day. Working tanks were located at the terminals only and the intermediate stations were operated on a closed system. Facilities today remain virtually as originally installed except for the removal of four pumping stations on the 10-in. line. The capacity of this segment is now 52,000 bbl. per day. Fig. 1 shows diagrammatically the system as it is today.

All stations have electric-motor-driven centrifugal pumps. Baytown has two four-stage pumps driven by 350-hp. 3,600-r.p.m. motors and one six-stage pump driven by a 450-hp. motor at 1,800 r.p.m. Hankamer and Fannett stations each have two 350-hp. 3,600-r.p.m. motor-driven four-stage pumps. The three units at Port Neches and two each at Buhler, Basile, and Courtableau consist of 500-hp. 3,600-r.p.m. motor-driven three-stage centrifugal pumps. Units at all stations are connected for series operation.

Modernization. The primary objective of modernization was to simplify operations and reduce operating expense. This was to be done principally by remodeling the relay stations between the terminals and providing them with equipment to permit unattended operation. Duties of dispatchers are to be undertaken by terminal-station operators in accordance with planning formulated by a schedule coordinator.

Remote-control scheme. The modernization plans call for Hankamer and Fannett to be controlled from Baytown and for the three relay stations east of Port Neches to be controlled from Port Neches. Supervisory control and telemetering being installed will be a space-code digital system transmitted over a leased telegraph channel. The operator at the controlling station will be able to start and stop individual pumping units and the sump pump at the relay stations.

How was Bayou born?

Bayou Pipe Line System dates from a 3-day Tulsa meeting starting March 23, 1942, when 100 leading pipeliners responded to the request of Petroleum Administration for War (PAW) to propose projects for counteracting the disruption of oil movements by submarine sinking of tankers. Among 10 specific projects recommended, Project 2 (a) provided for building the Bayou system for moving products from the Houston, Texas City, and Beaumont areas to the Baton Rouge terminal of Plantation Pipe Line. (In the Tulsa plan were Project 8—the Big Inch—and Project 9—the Little Big Inch.) Tulsa-plan projects were authorized by PAW on May 11, 1942; by February 1943, the Bayou system was completed.

Early completion was a feat since all materials were salvaged from abandoned oil wells, other lines, and pumping stations.

Bayou Pipe Line System is now owned by Shell Pipe Line Corp., Crown Central Pipe Line & Transportation Corp., Atlantic Pipe Line Co., Plymouth Pipe Line Co., Pure Transportation Co., and Service Pipe Line Co. Shell Pipe Line designed, constructed, and operated the project.

Shell Pipe Line turned over the operation of the Bayou system to Service Pipe Line on January 1, 1960. Shell and other participants had been studying the feasibility of modernizing the system for some time. Coincident with undertaking operational responsibilities, Service was authorized to design and install facilities which would make the system more efficient.

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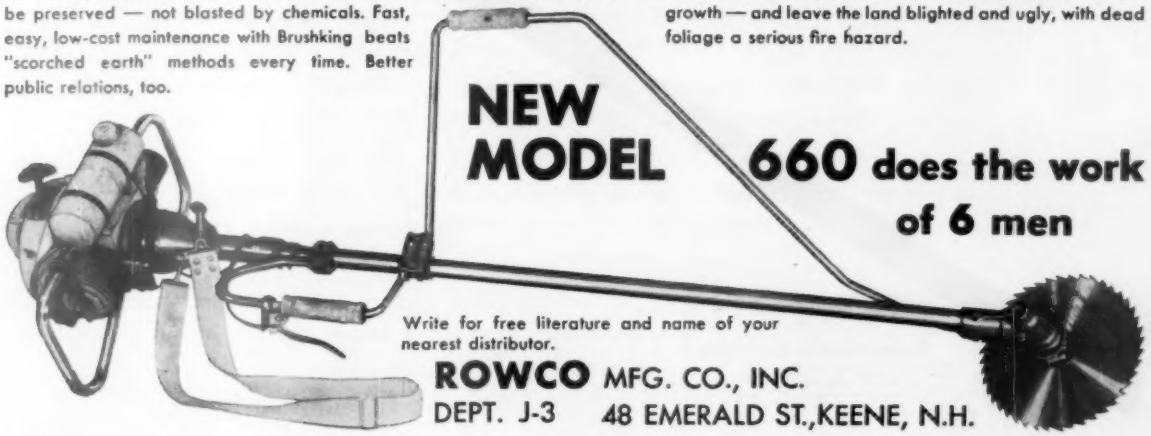

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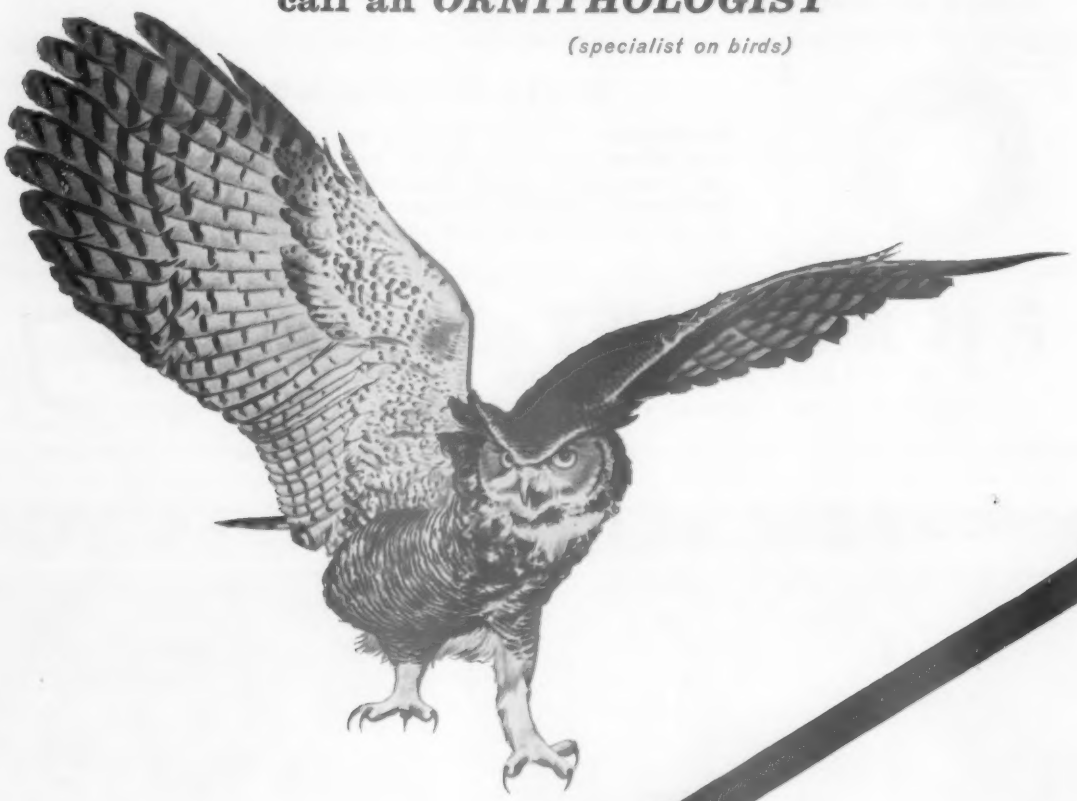

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Indication lights will show the running or stopped condition of these units. Telemetered variables consisting of flow rates and pump suction, case, and discharge pressures will be displayed on digital indicators for direct readout. Telemetered information will be kept current by adjustable automatic programing, on demand by the operator or by deviation monitoring of the discharge pressure at the relay stations. Other conditions at the relay stations will be shown by indication lights at the control stations. These are as follows:

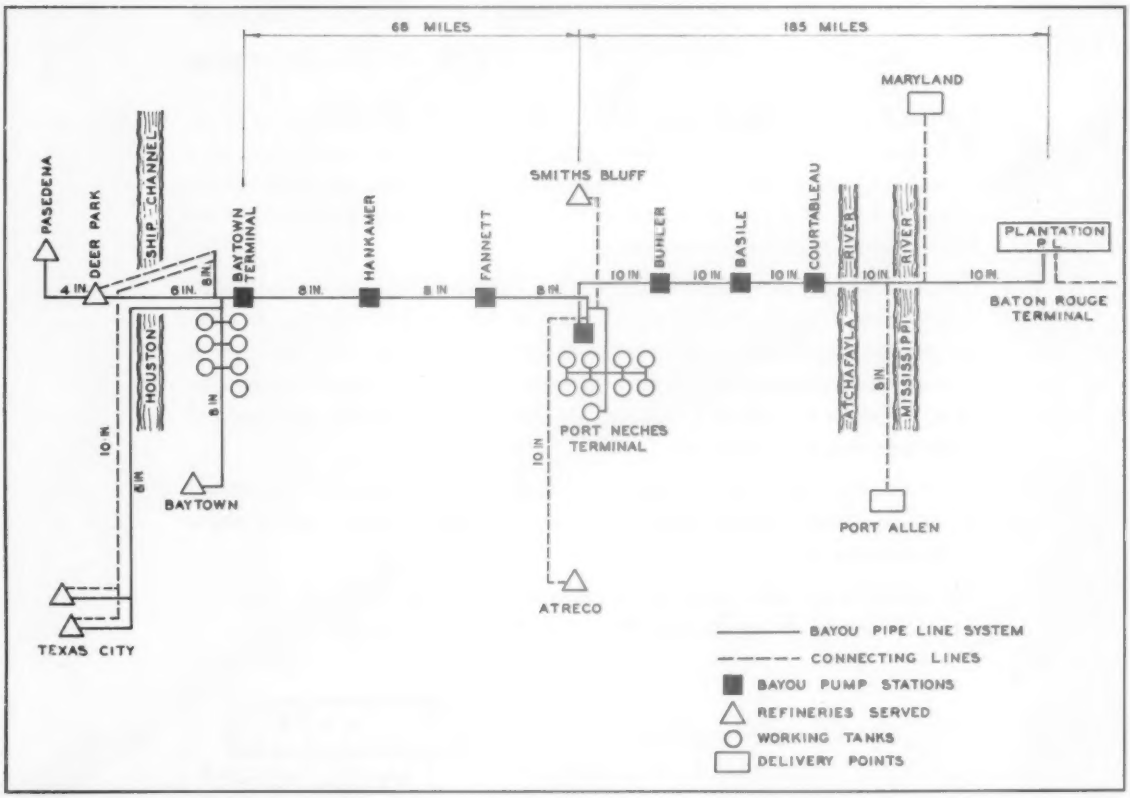
1. Deviation alarm.
2. Low instrument air.
3. Explosive atmosphere in motor room.
4. High sump level.
5. Scraper passing.
6. Station undervoltage.
7. Excessive discharge pressure.
8. Unit 1 machinery fault.
9. Unit 2 machinery fault.
10. Unit 1 isolation gate closed.
11. Unit 2 isolation gate closed.

Sump control. Sump pumps at the relay stations are to be operated from the controlling stations. This is required because on a system handling various products it is not permissible to discharge the sump into all products passing a station. To do so automatically without elaborate equipment for sampling the passing stream might introduce degrading elements into products such as fuel oil and premium gasolines.

Existing sumps are being revised to eliminate need of water and product separation. This is possible because water cooling of the main discharge-pump packing glands will no longer be required after the pumps are remodeled. Level detectors will control the shutdown of the sump pump, alert the operator at the control station that the sump should be evacuated. They will shut down the station when a dangerously high sump level is reached. Sump pumps are double-acting duplex piston-type reciprocating pumps. These will not be changed except that screw-type packing glands will be substituted for the existing flanged glands.

What's an "undivided interest"?

IT IS a multiple-ownership arrangement in which two or more companies arrange for the building of a pipeline and individually own undivided interests in the facility. Each owner-company makes the investment in the part of the facility it owns and pays its own operating costs. Each company individually files tariffs in its own name, solicits traffic for its share of the capacity, collects the transportation revenue that results from shipments thus obtained, pays its own taxes, files the required reports with federal and state agencies in its own name, consolidates the accounting items as a part of its company accounts, and in every respect operates as a separate carrier. For convenience and economy, the pipeline facilities are mechanically operated by one contractor under separate contracts between the individual owner-companies and an operator which usually is one of the owner-companies but could as well be a nonowner.



BAYOU SYSTEM, showing connecting lines, pump stations, delivery points, working tanks, and refineries served. Fig. 1.

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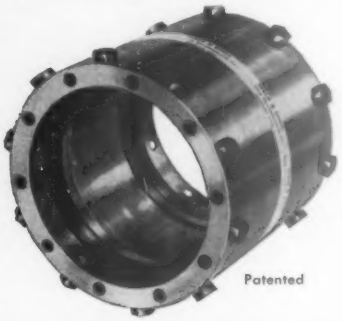

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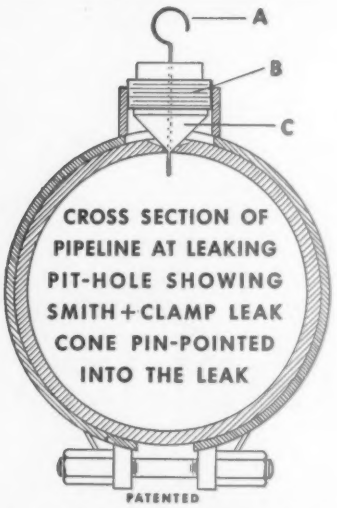

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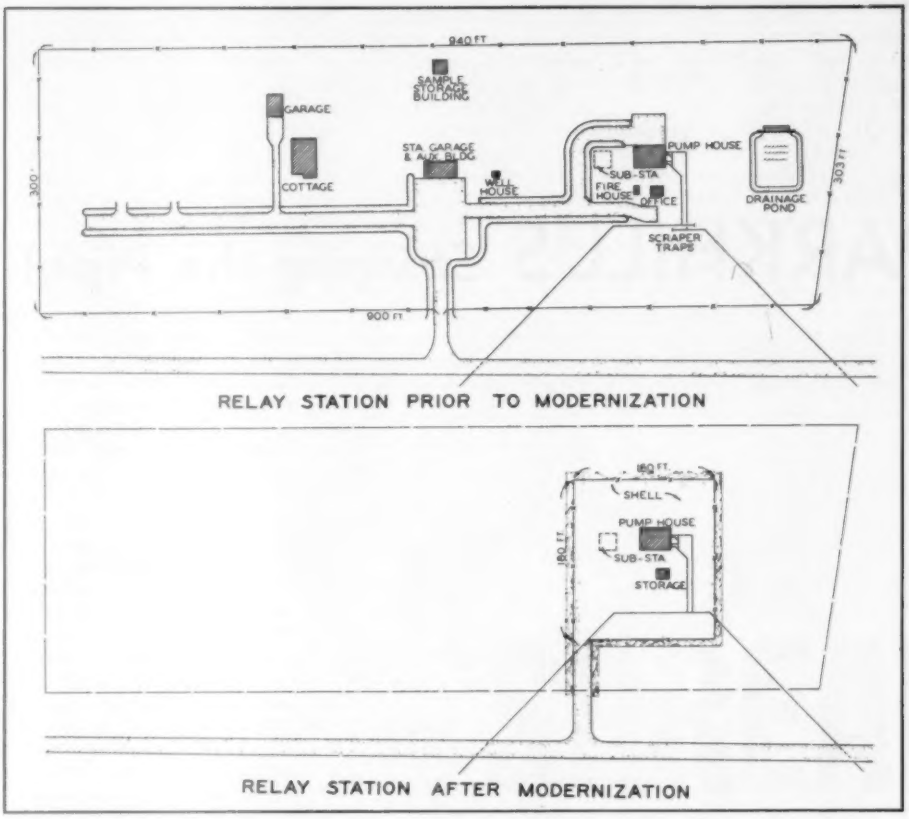

CONVERSION of relay stations to unattended status calls for considerable revamp and simplification. Fig. 2.

Main unit alterations. Major alterations to the pumps involve machining of stuffing boxes for installation of single-type mechanical seals, replacement of Kingsbury thrust bearings with ball-type thrust bearings as well as the removal of most of the packing gland and breakdown bushing piping including the water system used to cool the glands. Alterations also include installation of new pump shafts and temperature, vibration, pressure, and seal-failure protective equipment.

It would be impractical to attempt unattended operation of the pumps without making these alterations. Aside from the customary protective equipment being installed it was mandatory to change the pump packing to mechanical seals. Water cooling for the packing glands was a great nuisance. This cooling consists of a trickle of water playing over the shaft which is carried away with normal gland leakage to the station sump where it is separated from the products by gravity. Experience indicated that mechanical seals would not work satisfactorily without first limiting the lateral movement of the pump shafts. Therefore, ball-type thrust bearings are being used to replace the Kingsbury bearings.

The mechanical alterations to the pumps have resulted in a significant improvement in efficiency. From data and tests made on the pumps converted to date, an increase of 3 to 7% in efficiency will be realized. This is a direct result of the lower friction of the seals and the decrease in fluid losses from the high-pressure stages back to the pump suction that had been required to reduce the pressure acting on the original packing glands.

The pumping-unit motors are being left virtually intact. The motor shafts are being shortened to provide space for easy removal of the floating shaft and coupling hubs when servicing the inboard mechanical seals. Safety devices being installed include bearing-temperature sensors and space heaters of higher wattage.

Station-yard lines. The station manifolds which were above ground are being replaced with fabrications which will be laid below grade. Motor-operated suction and discharge gate valves are being installed on each pump to assure positive isolation of the pump in event of mechanical faults and to assist in successfully accomplishing automatic sequenced starting. The station control valve and the individual control valve on the discharge line of No. 1 unit are being retained. The double control-valve installation is necessary because of the limited case pressure which can be tolerated by the No. 2 pump. The discharge pressure of the No. 1 unit must be controlled when the units are operating in series under certain conditions of line pack and fluid passing individual stations.

New suction-line strainers are being installed at each station. These are made with quick-opening closures and jib cranes are being provided to facilitate maintenance of the strainers.

Scraper traps at the intermediate stations are being removed and scrapers will bypass the stations through a synthetic seated check valve. A detector in the incoming line will automatically shut down the stations when scrapers arrive and signal the controlling station that the scraper is passing that point. Startup of the station will be accomplished by command from the controlling station after a detector on the outgoing line extinguishes the scraper-passing alarm and indicates that startup is permissible.

Station controls. The relay stations have reduced voltage sections in the main motor starters. These sections will be removed and the starters set side by side to make room for the sequence-control and remote-control cabinets. The sequence control provides for local and remote control

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of the unit start-and-stop functions and for interlocking control of valve operation and safety devices. This control cabinet will include an annunciator panel which will display the cause for station shutdowns. This information will assist the maintenance personnel in taking corrective action by directing them to the proper fault.

Some 25 items will be shown locally which for the most part will be indicated at the controlling station only as a machinery fault. These will be triggered by safety devices.

The pneumatic control system at the stations will be retained. However, dual-element suction and discharge-pressure controllers will replace the obsolete equipment being used. In addition, the value of the secondary current from the transformer of the No. 2 motor starter will be used to detect and control motor load. The 0 to 5-amp. signal will be converted to a 3 to 15-psi. air signal and fed to a pneumatic indicating controller. The lowest output signal from suction, discharge, and motor-load control elements will position the discharge-line control valve. A pneumatic control-valve programer will be furnished for regulating the rate at which the control valve can open during startup of a unit. This will reduce the possibility of overloading the motors or experiencing low suction pressures while bringing a unit on the line.

In conjunction with the pneumatic control system a pneumatic positioner is being used for the first time to position an encoder for transmitting telemetered variables of pressure and flow. The pneumatic positioner was specially adapted by the manufacturer to position the encoders and seems to possess advantages of easy maintenance, economy, and reliability.

Station-site remodeling. In addition to the changes being made to the machinery and station piping, other facilities are being given attention.

The station pump houses are of brick construction with a Masonite partition between the motor room and pump room. The motor room houses the switchgear and transformers in addition to the motors. Both rooms are ventilated by suction fans in the attic of the building. It is planned to retain forced ventilation only for the motor room. This is necessary since the motors are of open type and require supplemental ventilation. The pump room will be opened to the outside by removing the major part of the three outside walls. The partition wall will be covered with a skin of sheet steel to protect against the elements.

Outbuildings such as cottages, garages, workshops, water wells, and flood-control pump houses are being disposed of. Station water supplies will not be retained when unattended operation is undertaken. The well-groomed grass and flora at the station sites will be eliminated. The grounds will be reduced in size commensurate with operational needs and enclosed within a security fence. The area inside the fence will be covered with shell to reduce maintenance and guard against fire, and dikes will be provided to protect many of the stations from high water in the bayous. A comparison of the present and future station sites is shown in Fig. 2.

Attention is also being given to the stations at Baytown and Port Neches in the form of consolidating operations and disposing of surplus buildings. The operator's office and remote-control equipment is being relocated to a brick building formerly used for storage. This building has been remodeled to include a laboratory for testing samples of products formerly done in separate quarters. Modern lavatories, air conditioning, and adequate record storage is also provided in this building.

The working tanks at the terminals have been provided with remote gaging equipment under the modernization program. Gaging can now be made from the operator's office.

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BY CLARK H. CRAFT
Chief Engineer,
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ARTHUR REINE
Mechanical Engineer,
Little Big Inch Division,
Texas Eastern Transmission Corp.,
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LAFAYETTE STATION, new installation on Texas Eastern's Seymour - Chicago line, is remote - controlled, automatic booster.

Texas Eastern installs

Remote-controlled engine-driven station

on Little Big Inch

Texas Eastern Transmission Corp. boosts throughput on lateral with remote-controlled automatic booster; diesel-driven centrifugal pump is installed in Indiana station.

EARLY THIS YEAR, Texas Eastern Transmission Corp.'s Little Big Inch division increased the throughput of its 14-in. products-pipeline lateral from Seymour, Ind., to Chicago by installation of a remote-controlled automatic booster station. Located near Lafayette, Ind., the approximate midpoint of the 233-mile line, this booster increased the design rate from 45,000 bbl. per day to 65,000 bbl. per day.

While the original Little Big Inch system is composed primarily of electrically-driven centrifugal pump stations, the high demand and seasonal-service factor of the Seymour station showed an economic justification for selecting an internal-combustion engine. This line handles gasolines, diesel fuels, kerosine, and fuel oils, and peak flow is required during the winter months when heating oils are in heavy demand.

For 7 or 8 months of the year, the Seymour station with its electrically driven pump can handle all requirements. Clearly, an internal-combustion engine could provide the additional power needed during the 4 or 5 peak months without incurring year-round connected-load charges for a big electric motor.

Equipment. The engine selected for the Lafayette station is a four-cycle turbocharged diesel, rated at 1,750 b.hp. at 514 r.p.m. It drives a six-stage centrifugal pump at 3,600 r.p.m. through a speed increaser. The station operates on a short bypass with a through-conduit check valve in the main line, providing for scraper passage.

Remote Control

A major element of interest in this station is the remote-control system. Under normal conditions, the station is controlled from the origin station at Seymour. The origin control operator, through a leased-wire circuit and a pulse-code control system, has three controls:

1. Start.
2. Stop.
3. Call out local operator.

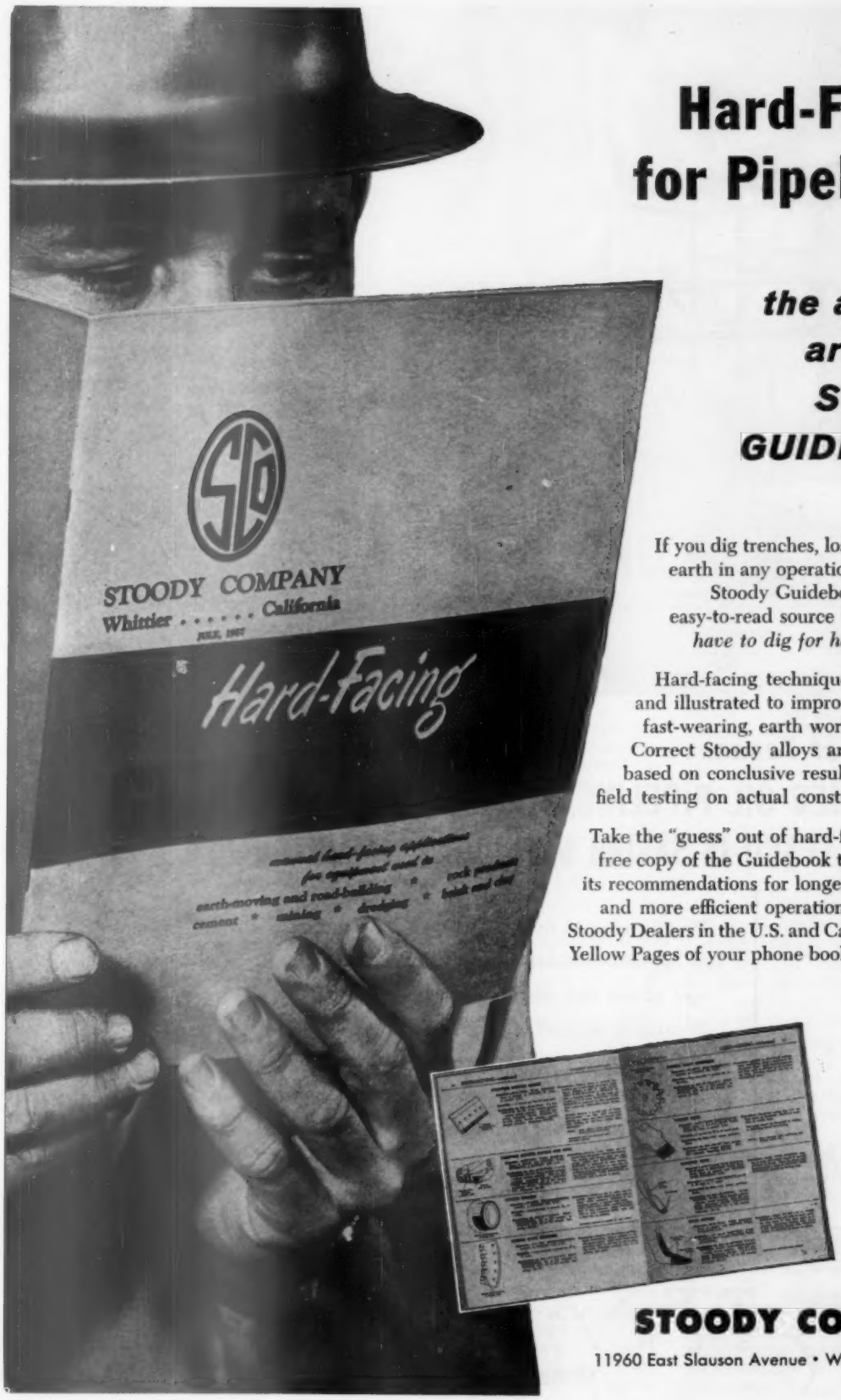
In return, he receives indications that:

1. Station is on.
2. Station is off.
3. Scraper passage.

The signal to "start" initiates a completely automated electrical sequence designed to protect the equipment against any malfunction of auxiliaries and to insure optimum starting conditions. It is a "forced sequence" in which each step is triggered by the successful completion of the prior step.

1. When the start signal is given by the remote-control operator, the main lube-filter pump, the crankcase vacuum pump, and the before-and-after pump for gear lube all start at once.
2. When gear-lube pressure builds up, it starts the engine-lube before-and-after pump.
3. Engine-lube pressure then starts the fuel-oil booster pump and also the jacket-water pump.
4. Jacket-water pressure starts the radiator water pump.
5. Radiator-water pressure, through a series of relays, admits starting air to the engine.

Two additional steps follow the starting sequence. First, the main gear-lube pump, driven off the gear, builds up pressure as the unit gets up to speed and this pressure then shuts off the before-and-after pump. Similarly, the main engine-lube pump, which is engine-driven, develops pressure as the engine starts up and turns off its before-and-after pump.



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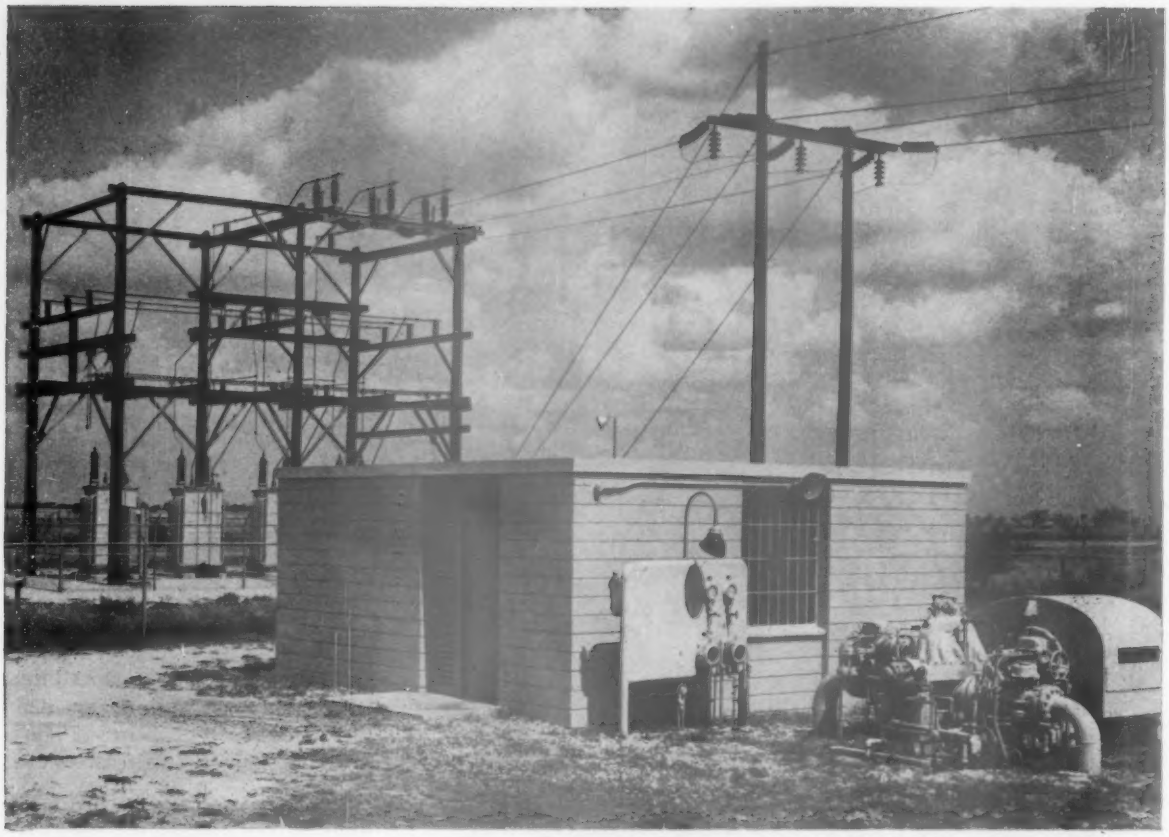

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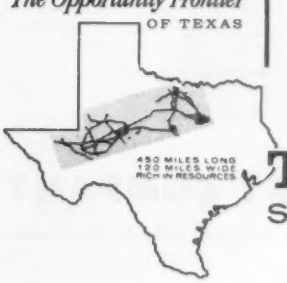

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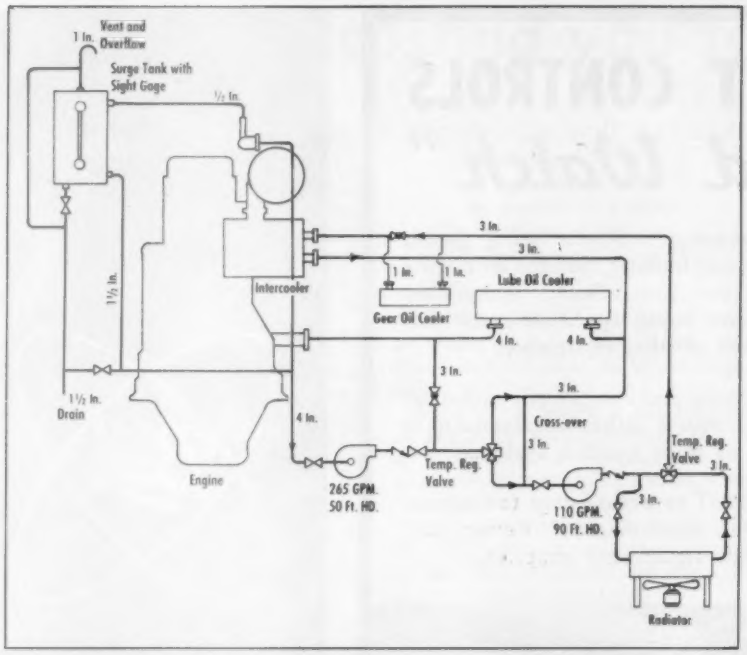

COOLING-WATER SYSTEM features "intelligent water." Motor-driven jacket-water pump discharges to the thermostatic proportioning valve which directs flow either to a cooling circuit or to suction of radiator-water pump.

There is one additional prerequisite to starting. After all the auxiliaries are in operation, the station suction valve must be opened before starting air can be applied to the engine cylinders for starting.

Starting. This complete starting sequence requires approximately 4 minutes from the time of initiation to idling speed, 3 minutes of which is the time required for the station-valve operators. Idling speed (300 r.p.m.) is maintained until the jacket water attains operating temperature, at which time a pneumatic dual controller working through a governor takes over, increasing engine speed to the desired operating point. The controller maintains the station at a preset discharge point with a suction override.

Minor but important changes and adjustments were made in this function so that the rate of control was correlated with the rate of acceleration and deceleration of the engine and with the rate of changing hydraulic conditions of the pipeline.

The forced sequence control system for starting was chosen over a programed or timed sequence because it was felt to be more responsive to existing operating conditions. For example, an arbitrary time sequence would not adapt to changing conditions such as ambient temperature. The forced sequence insures that each step is completed satisfactorily and then proceeds to the next without delay. In addition, it minimizes complicated circuitry and requires less equipment.

Safety. Safety devices monitoring critical temperature points and pressures are included in the control circuitry as would be expected in any automatic or unattended station. A temporary condition, such as low station suction pressure or high discharge pressure, automatically shuts the engine down. When the condition passes or is corrected, the diesel restarts automatically.

In contrast, when a malfunction occurs in the engine system itself, such as high-jacket water temperature or low lube pressure, the engine shuts down automatically, but the condition must be corrected and the shutdown device reset locally before the engine can be restarted. The station has an operator - attendant to handle daily routines and on 24-hour call to check malfunctions.

Coolant temperature control. Most interesting feature of the arrangement of auxiliary equipment is the Nordberg-designed cooling system which could be termed "intelligent water." In this system, the motor-driven jacket-water pump, rated at 265 g.p.m. at a 50-ft. head, discharges to a thermostatic proportioning valve which directs the flow either to: (1) a cooling circuit including the main lube-oil cooler and the diesel, or (2) to the suction of the radiator-water pump, another motor-driven centrifugal rated 110 g.p.m. at a 90-ft. head.

This pump discharges to a horizontal radiator with a thermostatic bypass valve, then to the engine intercooler and the gear lube cooler, after which the water joins the flow from the jacket water pump. The combined flow goes through the main lube cooler and the engine, and returns to the suction of the jacket-water pump. Finally, there is a crossover between the two outlets of the Amot valve on the discharge of the jacket pump, with water free to flow in either direction.

When water in the system is cold, the valve directs flow to the lube cooler-engine circuit, with part going back through the crossover to the suction of the radiator pump. Of course, this water bypasses the radiator until additional cooling is required. As water in the system heats up, the jacket-water pump discharge is directed to the suction of the smaller radiator pump with the excess flowing through the crossover directly to the lube cooler-engine circuit, combining on the way with cooled water from the radiator.

Flexible system. This combination of two regulating valves, the crossover, and a thermostatically controlled two-speed radiator fan provides a highly flexible and sensitive cooling system. In effect, the water is required to seek the proper distribution for cooling all components—hence, "intelligent water."

Though predominantly electric, the Little Big Inch is not unfamiliar with internal-combustion engines, having a 470-b.hp. unit at Tyler, Tex., a 375-b.hp. unit at Lebanon, Ohio, and no less than 15 engines on the Ark-La-Tex system extending from Carthage, Tex., to Arkansas City, Ark. The engines at Tyler and Lebanon can be shut down by remote control but must be started locally. The Lafayette station is the first engine-powered station in the system completely equipped for remote control.

The Lafayette station went into service in December 1959, and the diesel worked a heavy schedule in December, January, February, and a cold March. The Little Big Inch division, while not having had the opportunity to accumulate a long record of service, has been very well pleased with the over-all station, and with the selection and arrangement of equipment. Two more booster stations are now under construction on the Seymour-Chicago pipeline, one at Indianapolis and one near Lowell, Ind., incorporating engine-pump units almost identical to the equipment at Lafayette.

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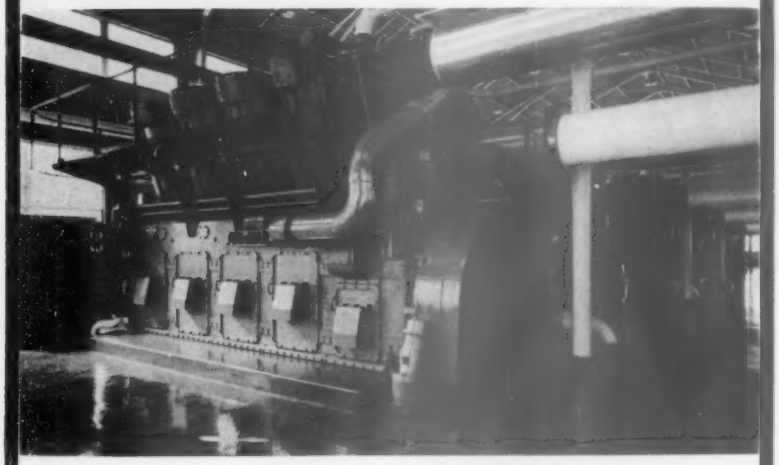
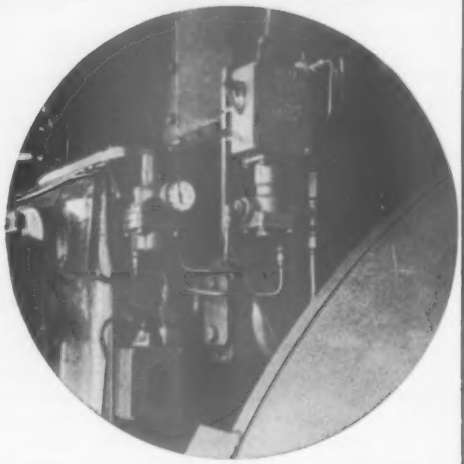


Shown in these installation photographs are 2000 H.P. Cooper-Bessemer Compressors at a new Tennessee station of the American Louisiana Pipe Line Company.



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Rig moves costing you too much?

Maybe some of these tips will save you some moving expense

BY MARVIN T. PARKER
Manager of Drilling
Great Western Drilling Co.
Midland, Tex.

TO MOVE A RIG in some areas costs as much as 20% of total drilling cost; this means moving methods must be as efficient as possible. And the equipment must be designed for quick, inexpensive transport.

Presented here are a number of moving ideas which are not common practice in many areas but which have proved real time and money savers.

Not all ideas fit all rigs; the smaller trailer-mounted unit weighs only a few hundred thousand pounds while the larger land rigs weigh more than a million pounds. In this discussion we consider only the larger land drilling rigs which normally work under jackknife masts.

Before any move starts, there are certain things essential for an efficient operation. These are good truck personnel, good trucks, a planned schedule for each major piece of equipment, and equipment designed for rapid assembly. The location where the rig is to be assembled should already have been leveled with a transit since draw works, engines, and mast must be level to insure alignment.

From a paper titled, "The Mechanical Aspects of Rig Moves," presented at the 1960 Petroleum-Mechanical Conference of ASME, New Orleans, September 20.

Then, a real help is a location plan or sketch of the rig layout. This is an inexpensive way to insure best possible setting up of rig equipment when it is unloaded at the location.

With all these things in hand, then the most efficient move is a matter of how the equipment has been designed, unitized, and fitted.

Compromises to make. The rotary rig would be easier to design and cheaper to build if it did not have to be moved. Unfortunately, some rotary rigs of today move as often as once a week. Then again, the rig may be on one location more than 2 years. Cost per foot of hole is higher when the rig moves more often.

As a result, rotary rigs have been highly unitized and are designed so that they go together the same way after each move. Many items are standard so that they may be installed quickly on any rotary rig, regardless of size.

If we go back about two decades, we could find almost as many different rigup designs and moving techniques as there were supervisors. During the past few years the trend has been to standardize rigup designs and design each rig so that it can be moved and assembled quickly with minimum cost. The influence of the design engineer has now followed the rotary rig into the field where it will be used and moved.

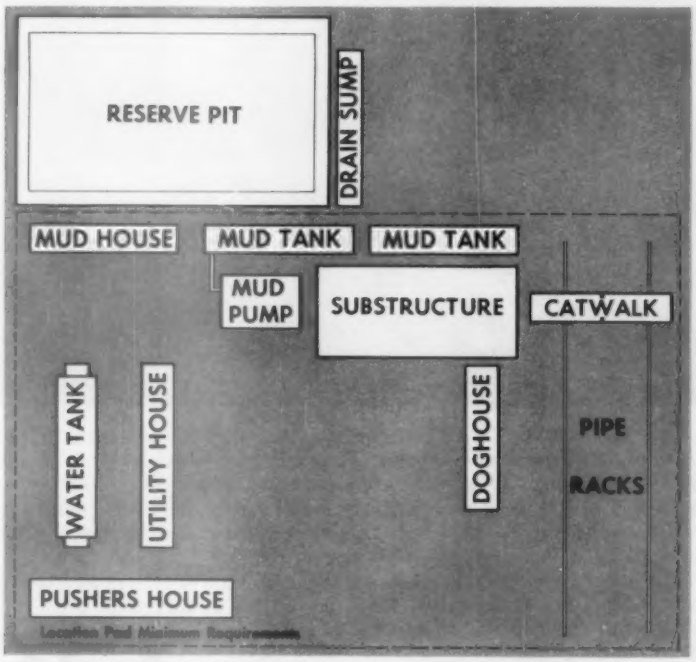
Putting base down. Most substructures today are plated on the bottom with ⅜ or ½-in. plates; this eliminates the use of matting boards. The old-style narrow box substructure may be plated wide enough for sufficient bearing surface by building an outrigger on each side of each box. This also permits easier handling with trucks; the extra width prevents the substructure half from turning over.

Slush pumps may also be plated to eliminate matting boards. Both substructure and slush pumps remain more nearly level than if set on matting boards. And the raised mast will be level if the substructure is level.

The rotary table may be quickly set in correct position for perfect alignment if V-blocks are used. The V-blocks (of 1-in. plate) are welded to the rotary-table support beams, and the matching piece is welded to the side of the rotary table. With these, the rotary table is automatically aligned when set in position. For speedy replacement of the rotary sprocket, a quick-change-type hub and sprocket should be used.

After the draw works is set on the floor, it is moved into correct alignment by using a forward and side stop welded on the substructure.

With a standard derrick and detached substructure, alignment and spacing of the input chain are critical. This operation may be simplified by using a pinned spacer beam on each side of the input chain. Center of the pin connection must be the same as the center of input and output sprockets. After substructure, compound, and engines are set and the spacers pinned, distance between the output and input sprockets will be the same regardless of variations in height. The spacers rotate the output sprocket



LOCATION PLAN showing rig equipment layout is a real aid in getting equipment set up in its proper location when it arrives on location. In addition, such a plan insures that water, air, and electrical systems "fit" the layout.

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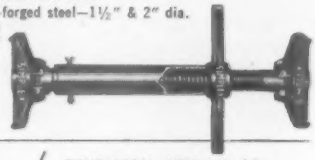

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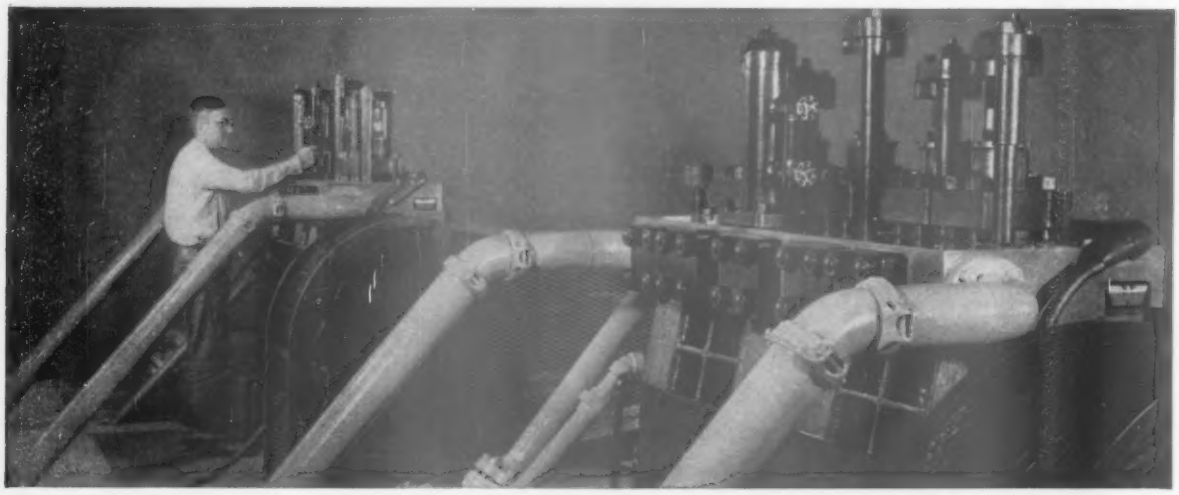

STOP AND SEE

Stop and see this Blackwell Oil & Gas Company installation at their North Happy Valley Unit, Cushing, Oklahoma. It's two Worthington vertical multiplunger pumps doing a good job of handling salt water disposal . . . currently injecting 5800 and 4500 BPD each.

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around the input sprocket and insure the input chain and chain guard fitting each time the rig is assembled.

The compound should be a sectional type mounted on each engine skid. Engine and compound are set and aligned by using dowel pins and welded stops.

Each engine skid also carries a section of the engine shed. Thus, the shed is complete when all engines are in place, and there is no need to build a shed from individual sections. The engine-shed outside wall and rig-floor walls should pin together rather than bolt; any pin connection is faster to assemble than a bolted connection.

A pump belt guard of trough design can be installed by the crews without a truck.

Surface mud system. The mud tanks are a large part of the rig and may require too much time to rig up if not properly designed as a unit. For example, the shale shaker is mounted so that it can be moved in place. All plumbing should be fixed in place and the mud jets should swing back over the tank to allow moving without being disconnected.

Mud tank and suction risers should mount permanently in the mud tank. Suctions and mud-flow connections may well use a pneumatic connection for fast assembly; these seal properly even with some misalignment.

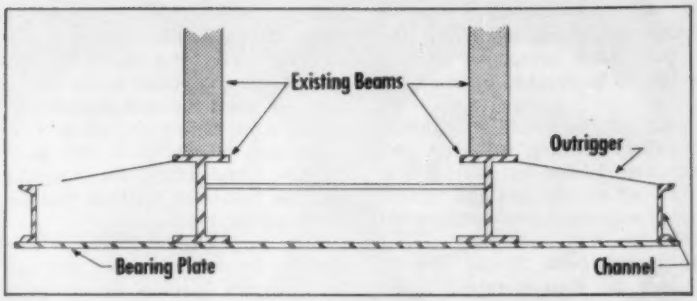
A sample house built into the body of the tank on either end eliminates moving another house.

If the substructure is too low for the mud-tank bottom to be at ground level, a sling should be made on the loading hitch. This sling of wire rope should be permanently installed and hooked on the top of the mud tank above ground level. This simple hookup speeds up rig moving. If the loading hitch were on the bottom of the mudtank, the crew would have to dig it out in order to secure the truck winch line.

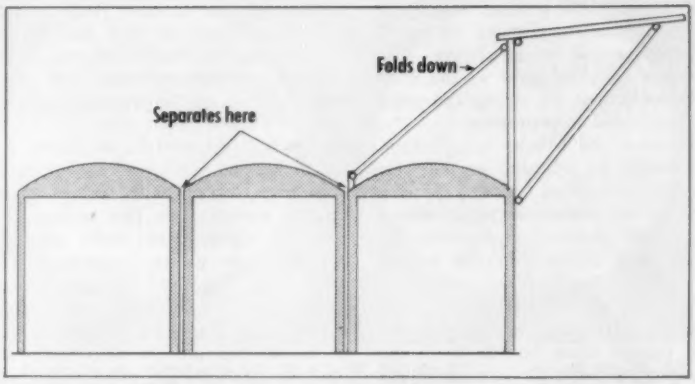
Utility loads. One load can be eliminated if utility house and storage house are designed into one unit. With the light plant, air compressors, water pump, and air volume tanks mounted in the utility house, time is saved since each piece of equipment is not handled separately.

A well-designed water-storage system contains at least two 500-bbl. horizontal skid-mounted water tanks. Horizontal skid-mounted tanks are easier to load on a truck, move, and install at the new location. Plumbing, including the overflow, should be an integral part of each water tank. For cold-weather operation, the skids may be made approximately 4 ft. longer so that a freeze box may be constructed around the outlet valve.

Since the mud-storage house is usually empty during moving, it may be easily used for storing hoses, canvas windbreaks, and other lightweight or easily damaged equipment. Construct a lightweight box large enough for all the light fixtures and sizes to fit into the mud house; it will protect the light system while moving.

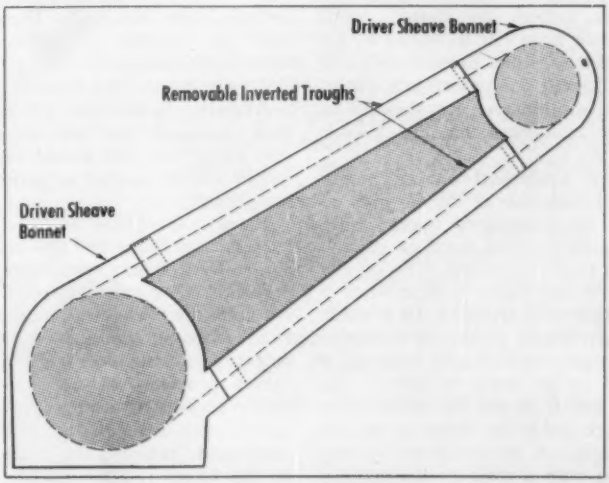


OUTRIGGERS AND BEARING plate help prevent settling of the rig during drilling, as shown in this cross-section of a narrow box substructure. No matting boards are necessary with such a substructure.



INDIVIDUAL ENGINE SHED is elevated over draw works. This arrangement, for a dual-level substructure, has each engine skid carrying its own section of shed, so that the shed is complete when all engines are in place.

Making final lineup. After the major equipment is on location, the details of final assembly are quite often very time consuming. After the substructure has been centered exactly over the stake and the rotary table set, the process of alignment begins. The draw-works rotary output sprocket should be checked for alignment with the rotary-table sprocket. Doing so



TROUGH-TYPE BELT GUARD for the rig's mud-pump drive speeds rigup, since it can be installed by the crews without a truck. Belts shouldn't be tightened until after the mast has been raised.

shows any misalignment resulting from damage during the move. The input chain from compound to draw works should be checked for the same reason.

Engine clutches should be dial-indicated before running to detect any misalignment caused by moving. For long life, all air clutches and flexible couplings must be aligned within 0.005 to 0.010 in.

Slush-pump belts should not be tight until the mast is raised, unless the slush pump is chained to the substructure. Otherwise the belts may be stretched and the pump pulled out of alignment if the rear of the substructure is lifted off the ground. The string method is usual for aligning the pump driver sheave and driven sheave. This method is only as good as the man who is looking at the string; the process could stand improvement.

Tension of the V-belts is important. They should be adjusted so that one belt can be pulled down approximately 4 in. with one hand. Pump belts should always be placed in the grooves next to the pump to reduce the load on the shaft and bearings; any grooves in the sheave not used should be on the outside of the sheave.

All pumps must be set level and kept level to eliminate stresses in the power end. Pumps, like any of the other equipment, should not be dropped when loaded or unloaded.

Air, water, fuel, and electrical systems are important factors in any rig move. A location plan means that each piece of this equipment will be placed in exactly the same spot each time, to insure that these systems fit together without time-consuming modifications.

Help in lifting loads. Air hoists can make any rigup faster and safer. During rigup, the cathead cannot be used until the engines are started. Until then, an air hoist (air furnished by air compressor in utility house) can move a lot of small equipment into place. Also the air hoist is very helpful in handling equipment on the V-door side of the rig.

Smaller equipment on the pump and mud tank side of the rig may be handled by a swinging boom (270° arc) attached to the mast or derrick leg. No truck is needed. The offside cathead is the power source when a boom is used. A typical beam is made of a 25-ft. length of 4½-in. drill pipe with a sheave on each end. One end is clamped to the mast or derrick leg. A wire line from the top of the mast or derrick holds the beam at the desired angle. A ½ or ⅜-in. soft-lay wire line with a rope on the cathead end is used to reeve through the two sheaves for hoisting.

Moving the pipe. On rigs drilling 4,000 to 6,000-ft. holes, a drill-pipe basket saves time and expense in moving drill pipe. This basket is made of drill pipe and placed beside the catwalk. It holds the drill pipe when it is laid down before the move. Cross pieces may be placed in slots across the top. These extend the pipe racks over the basket to facilitate handling other tubular goods.

After the basket is loaded, a truck can load the drill pipe intact and move it to the new location. Otherwise the pipe would be handled, a few joints at a time. When unloading, the pipe basket is placed beside the catwalk and the pipe removed as needed with a sling and the catline. As many as two pipe baskets on each side of the catwalk may be used if needed.

Don't overlook skidding. The skidding method of moving drilling rigs was developed more than 20 years ago. It has progressed into a very efficient way of moving short distances, over level terrain with soil of good bearing strength. In this process the complete substructure, erect mast or derrick, draw works, compound, engines, and rig-floor equipment are moved as one unit. The substructure is jacked up, large skid beams are put in the substructure, the skid beams set on wide track dollies, and large tractors are used to tow the rig to the next location.

Skidding is less expensive than complete disassembly and usually saves 1 or 2 days' moving time. After skidding, engine clutches should be checked to detect any misalignment resulting from the skid move.

More problems ahead. Moving and assembly methods of today are by no means the answer for the future. Tomorrow's deeper drilling will require larger equipment. Moving costs will rise. Highway load restrictions may become more stringent. These facts force the operator of drilling equipment to be constantly alert for better and more economical methods.

Already, lightweight alloy structural materials give the engineer a new design tool and should mean less weight will be needed to perform the same jobs.

Electric drive has made a comeback on rigs in the last few years and has solved some mechanical drive problems. For instance, wells which require more blowout-preventer equipment make it necessary to increase height of substructures. This, in turn, causes problems of excessive input chain length, overlong pump belt length, and difficulty in loading the compound, engines, and draw works on the floor.

Stepdown substructures have helped in loading the equipment on the floor and in keeping pump belts shorter. Still, too much stepdown distance increases input chain-length enough to require a jackshaft between compound output and input shaft. Length of the pump belts should be kept under 600 in. to insure good service.

An electric-drive rig can be used on a substructure of any height. Alignment problems are practically eliminated. Assembly time is cut since a plug-in connection is faster than a chain drive. All prime movers and generators are set on the ground, thus eliminating the time required to load and align this equipment on the substructure.

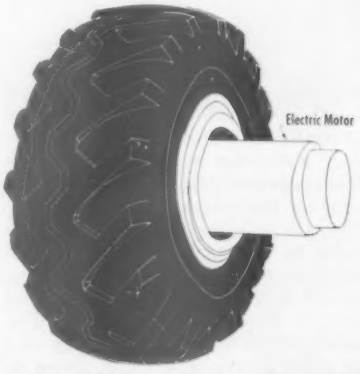
For the future. Some new concepts have evolved for moving in remote areas of the world. Large electric-wheel high-load-capacity trucks are being used to move larger units of the drilling rig together. This equipment was designed to transport heavy loads without building roads in desert areas and over other trails where the large rocks, trees, and severe grades had been removed. The large wheels have low-pressure tires, wide tread widths, and an individual electric motor built in each wheel. Power source is an engine and generator set with an electric conductor to each wheel.

Some of the large trucks on the market today might be used to move a complete mast strung up with blocks and drilling line.

This would require that the mast be modified to strengthen the angle braces where it would be supported by the rolling tailboard and headache rack. All auxiliary equipment could be skid mounted on large skids and the number of loads decreased. Possibly the truck could also be designed to be coupled up short with a blade on the front.

Acknowledgment

Acknowledgment is made to Louis P. Nell, rigup and design engineer for Great Western whose assistance in preparing this paper was invaluable.



ELECTRIC WHEEL, similar to those used on big earth-moving equipment, is a good bet for easing rig moves of the future.

MEETING TOMORROW'S DEMANDS...TODAY

Oklahoma Natural Gas Company's integrated pipeline system — for transmission and distribution — traverses the greater part of the State of Oklahoma.

As a "working partner" in the state's industrial expansion program, ONG is actively engaged in the development of new natural gas reserves. We are always interested in tying in newly discovered gas production to our pipeline system, currently keeping closely in touch with exploration-drilling operations in Kingfisher and Hughes counties.

New and expanding industry can be assured that ONG will cooperate to the fullest toward providing an ever-plentiful, economical supply of natural gas — for today's requirements, for tomorrow's increased demands.

ONG

OKLAHOMA NATURAL GAS CO. TULSA, OKLAHOMA

A tower rises in Texas

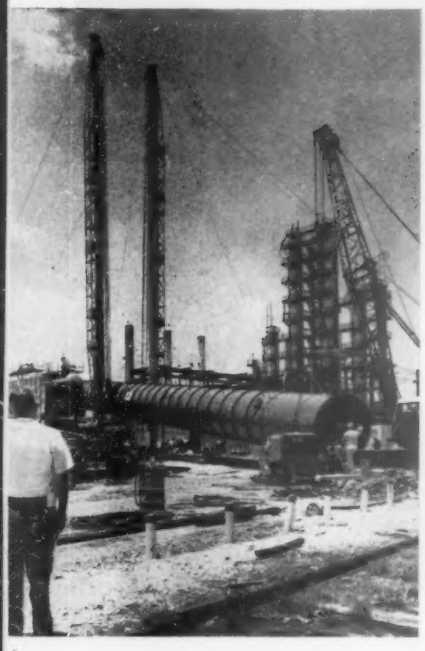
BY H. C. BOZEMAN
Gulf Coast Refining Editor

A NEW debutanizer tower has been installed by Gulf Oil Corp. at its Port Arthur, Tex., refinery. The tower, one of the heaviest erected in a single lift in the oil industry, makes high-purity isobutane for alkylation into Gulf's premium and avgas.

Erected complete with trays, the tower weighs 195 tons and is 196 ft. 4 in. high. Its diameter is 12 ft., the shell is made of ¾ in. thick steel, and the skirt is 20 ft. high.

DELIVERY. The deisobutanizer was built at U. S. Steel's American Bridge Division plant at Orange, Tex., 18 miles from the erection site. It required five rail flat-cars for loading. The tower was cradled on the second and fourth cars.

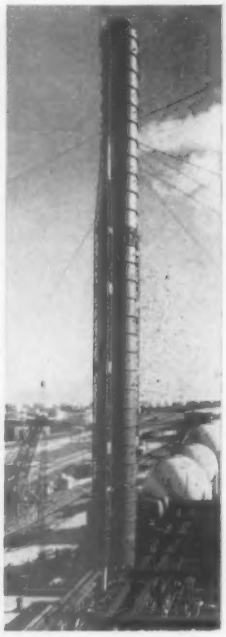
It was delivered by special train during daylight hours over the Southern Pacific Lines from Orange to Port Arthur via Beaumont.



BIG LIFT STARTS. Placing the tower in correct position for erection was difficult because clearances were close, 3 ft. on each side and none at the top.

Treco used two special gin poles for lifting the tower. Each pole had a capacity of 150 tons. The poles were borrowed from another contractor, and one was moved in from California.

Heavy lifting cables were secured to the tower at a point above its center of gravity. Wood blocks between the cables and the tower prevented damage to the shell.



HALFWAY UP. A crawler crane lifts the skirt section and walks it into position over the foundation as the blocks on the gin poles raise the top.

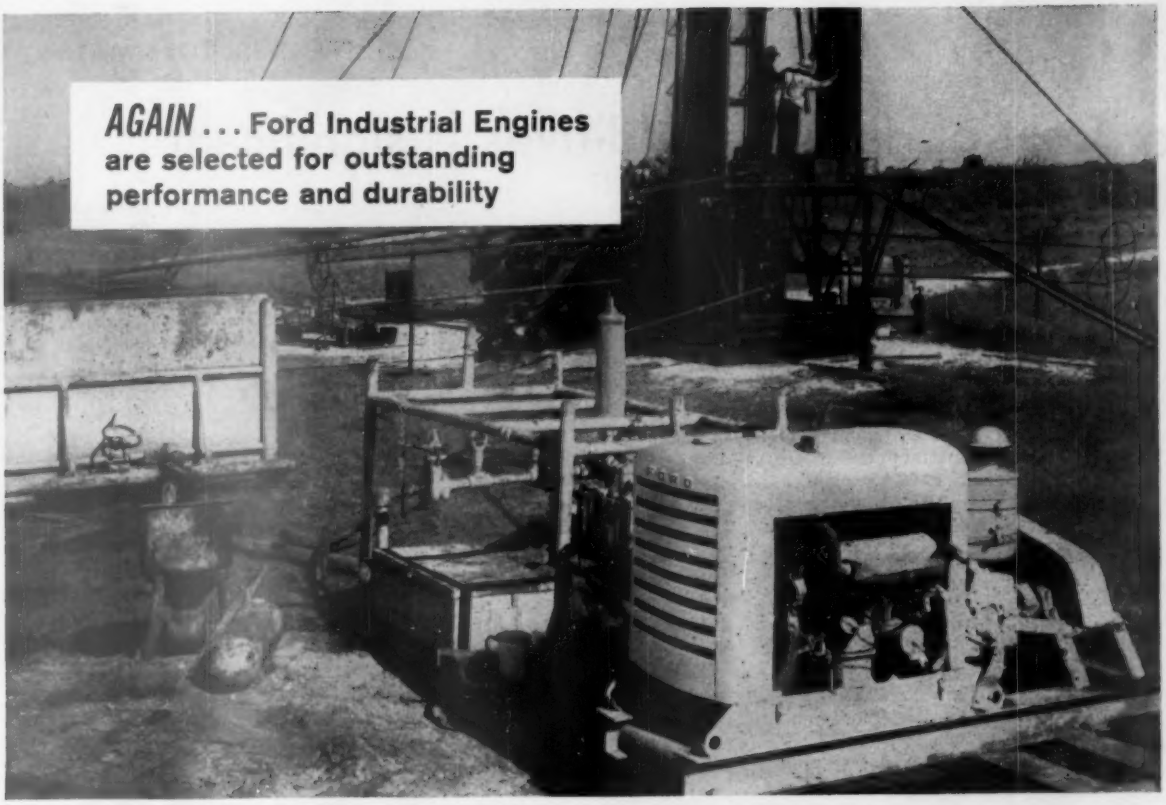
The lifting winches on each gin pole and the crawler crane are coordinated by a signalman. Close coordination is needed to keep the blocks on each pole at the same level and in the same vertical plane as the center line of the poles.

During erection the adjacent refinery units continued operations with special crews standing by to make a quick shutdown in case of any mishap.

The final step was to lift the tower free of the ground for alignment with the 32 anchor bolts in the concrete foundation. The full weight of the tower was now carried by the gin poles.

A line from the crawler crane turned the tower to align the anchor bolt holes in the bottom of the skirt with the anchor bolts.

It was 4½ hours from the time the tower first left the ground until the anchor bolt nuts were tight.



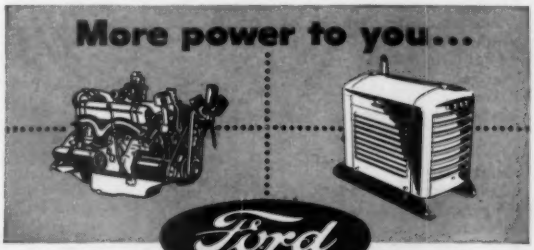
Rugged Ford-powered rig is still going strong after pumping heavy mud for 3 years!

The work-over rig shown above performs the essential task of "killing" oil wells with heavy mud or strong brine while they are being serviced. Its operator* reports that the Ford 272 Heavy Duty V-8 in the rig has been in constant use for 3 years . . . providing needed power *with no trouble at all.* Just as Ford power contributes to the effectiveness of this unit, a Ford Industrial Engine can bring a new kind of efficiency to your oil field equipment.

Ranging from 134 to 534 cubic inches, Ford engines offer many durability features including Short Stroke design that reduces friction and wear . . . Deep-Block construction that permits smoother operating performance . . . and full length water jackets that provide better cooling for longer engine life. Thanks to features like these, Ford engines give you an added bonus: *more horsepower per pound of engine weight than ever before possible.*

All Ford engines, including Ford's two modern diesels, are available as complete engine assemblies or power units. Gasoline engines can be adapted to LP-Gas or natural gas fuel. And because these engines can be serviced by any nearby Ford Dealer, costly downtime is cut to a minimum.

For more profitable production, it will pay you to power or repower your oil field equipment with a rugged Ford Industrial Engine. **Name on request*



FORD POWER IS RIGHT FOR YOUR OIL FIELD EQUIPMENT, TOO!

INDUSTRIAL ENGINE DEPARTMENT, FORD DIVISION, FORD MOTOR CO., P.O. BOX 598, DEARBORN, MICH.

West of Rockies write to:
FORD INDUSTRIAL ENGINE DEPT., P.O. BOX 6787, LOS ANGELES 22, CALIF.
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Cost of gasoline additives is significant

BY W. L. NELSON
Technical Editor and Petroleum Consultant

THE USE of tetraethyl lead in gasoline obviously constitutes a very large cost, but the cost of other additives is also significant. The cost of tetraethyl lead fluid in 1956 was at least $280,000,000 and other additives constitute a cost of $23,000,000 or more (Process Costimating No. 64, Chemical Consumption in Petroleum Refining, 1956, January 11, 1960, page 97). The amount of tetraethyl lead used in gasolines since 1926 was outlined in Process Costimating No. 68, March 21, 1960, page 127.

The amount of each additive used in motor fuels is indicated in Table 1. Dyes and antioxidants are used in substantially all gasolines, and these constitute a cost of only about 0.6 cents per barrel. The other additives are not used in all gasolines, and the total cost of all other additives (excluding TEL) is about 1.3 cents per barrel:

	Cents per barrel		
	Least additives	Maximum Additives	Average
Antioxidants	0.5	0.5	0.5
Dyes	0.1	0.1	0.1
Other additives	0.3	12.0	1.3
Total (excl. TEL)	0.9	12.6	1.9

Upper-cylinder lubricants and antiicing agents are relatively expensive. The use of either of these types of additives may more than double the cost of additives (excluding TEL).

Table 2 indicates the approximate yearly cost of the various gasoline additives. To arrive at totals it was necessary to adopt dosages and prices (Table 1) and to estimate what proportion of the total gasoline (3,800,000 bbl. per day—1956) is treated with each type of additive.

The more common **antioxidants** contain:

2,6-di-t-butyl-4-methyl phenol.

N,N'-di-sec-butyl-p-phenylene diamine.

2,4-dimethyl-6-t-butyl phenol.

N-butyl-p-aminophenol.

Common **dyes** are:

Yellow, p-dimethylaminoazobenzene.

Orange, benzene-azo-2 naphthol.

Red, methyl derivatives of azobenzene-4-azo-2-naphthol.

Blue, 1,4 dialkylamino-anthraquinone.

The cost of azo dyes (yellow, orange, and red) averages about $1.43 per pound (range $0.64 to $1.56) but the anthraquinone dyes are more expensive, ranging up to even $5.39 per pound.

Isopropyl alcohol, glycols, formamides, etc., are one type of antiicing agent and although they are cheap, a large amount (1-8 lb. per bbl.) must be used. Less is known about the more powerful surface-active agents (amine or ammonia salts of phosphates) which are also used for antiicing.

Some of the current metal deactivators are:

N, N'-disalicylidene-1,2-diaminopropane.

N,N'-disalicylal ethylene diamine.

Salicylal-orthoaminophenol.

Among **antirust** agents are unsaturated organic acids, alkyl acid orthophosphates, amine and ammonium sulfates, and fatty acid amines. A wide variety of cleanliness agents are used for fuel-induction systems. Such agents are either of the oil-base type, or the surface-active type which are said to prevent the sticking of dirt to the walls of the equipment.

TABLE 1—USE OF ADDITIVES IN GASOLINE (1956)

Kind or type	Dosage lb. per 1,000 bbl.		Approximate cost $ per lb. active ingredient		Cents per bbl.
Antioxidants	5	(2-16)	$1.00	(0.80-1.17)	0.5
Metal deactivators	1.3	(1-3)	$2.00	(1.33-6.00)	0.26
Antirust	4	(2.6-13)	$0.50	(0.20-1.00)	0.20
Cleanliness	*500	(250-1,400)	$0.077		3.85
	or †12		or $0.95		or 1.14
Tetraethyl lead	2.25	cc./gal.	$0.218	ct./cc.	20.60
Dyes	0.7	(0.2-2.6)	$1.55	(0.7-3.00)	0.11
Preignition preventers	26	(26-52)	$0.37		0.98
Upper-cylinder lubes	500	(260-780)	$0.025	(0.02-0.04)	1.25
Antiicing	2,000	(1,000-8,000)	$0.05		10.0
	or †30	(13-1,000)	or ‡$1.00		or 3.0

*Oil-type cleanliness, etc., agents. †Surface-active and similar types. ‡Estimate.

TABLE 2—APPROXIMATE CONSUMPTION AND VALUE OF MOTOR-FUEL ADDITIVES (1956)

Kind or type	Percentage of gasoline treated*	Millions pounds	Millions dollars Computed	Other sources
Antioxidants	100	6.95	6.95	7.0
Metal deactivators	60	1.08	2.17	2.0
Antirust	30	1.67	0.84	1.0
Dyes	90	0.88	1.38	1.0 & 2.0
Preignition preventers	10	3.60	1.36	3.0
		14.18	12.70	
Others—10%	...	1.42	1.27	...
Cleanliness	30	†5.0	†4.70	...
Upper-cylinder lubes	5	35.0	0.87	5.0
Antiicing	10	4.2	†4.20	10.0
Total	...	†60-530	†24-44	28-30
Total (reasonable average)	...	‡108	26	...

*A gross approximation, introduced to show how totals were obtained.

†Estimate based on surface-active types of antiicing agents. If based on alcohol, etc., types, the pounds are 280 million and the cost about 14 million. Estimates based on surface-active types of cleanliness agents. If based on oil-type, the pounds are 200 million and the cost about 15 million.

‡Active ingredients.

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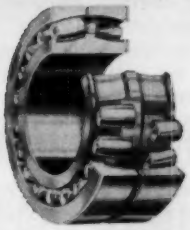
"Caged" for Longer Life!

The two land-riding cages in Torrington Spherical Roller Bearings assure proper roller spacing and guidance, even under rugged conditions of shock load and sustained high speeds. These fully machined cast bronze cages operate independently. Their design eliminates drag on rollers. These high-strength cages help bearings give longer life by providing low friction, smooth running and cool operation. Highly effective and generous lubrication of all contact surfaces is achieved with the open-end cage design.

The result: Torrington Spherical Roller Bearings are built to give extra years of unmatched service life in heavy-duty applications. Torrington's long experience in design, engineering and manufacture of every basic type of anti-friction bearing provides the finest spherical roller bearings available. You'll find it pays to standardize on Torrington.



Superior design features of TORRINGTON SPHERICAL ROLLER BEARINGS

- integral guide flange for roller stability
- asymmetrical rollers seek flange for positive guidance
- electronically matched rollers
- size-stabilized races
- fully machined land-riding bronze cages
- controlled internal clearances
- even load distribution
- inherent self-alignment
- long service life

progress through precision **TORRINGTON BEARINGS**

THE TORRINGTON COMPANY South Bend 21, Indiana • Torrington, Conn.

BY JOSEPH ZABA

Sucker-rod failures (continued)

Buckling of tubing

IN 1957 Arthur Lubinski and K. A. Blenkarn presented their theory of buckling of tubing during the pumping cycle and its effects on rod-on-tubing wear[1]. This theory is an outgrowth of Lubinski's original studies on buckling of drill pipe.[2]

It was shown mathematically that in a pipe terminated by pistons the internal pressure exerts buckling effect on the pipe as if the pipe were subjected to column loading. In tubing in a pumping well, on the upstroke, with the traveling valve closed, the plunger acts as such a piston. The tubing buckles into a helix up to a certain neutral point, above which it remains straight. The effect is the same as that of an upward-acting force imposing column loading on the freely suspended tubing. Since the rods are in tension during the upstroke and therefore straight, they contact the helically buckled tubing. The result is rod-on-tubing wear at the points of contact. During the downstroke the traveling valve opens, the plunger ceases to act as a piston, the buckling effect is removed and the tubing straightens.

Existence of tubing buckling was first shown by a laboratory model. Field evidence has been now accumulated to support the existence and importance of buckling of tubing during the pumping cycle.

Magnitude of the buckling force is a function of the cross-sectional area of the plunger and of the differential pressure across the plunger. Therefore, for a given pumping depth, plunger size, and fluid gradient, the force is a function of the location of the working fluid level. The position of the neutral point, up to which the rod-on-tubing wear would be expected, depends on the magnitude of the buckling force and the weight of tubing in fluid, assuming that the neutral point is below the working fluid level. The formula for the buckling force f is $f = A\Delta P$ where A is the cross-sectional area of the plunger and ΔP differential pressure across the plunger. The distance n to the neutral point is $n = f/g$ where g is the weight per foot of tubing in fluid, assuming that the working fluid level is above the neutral point.

Calculations show that the buckling force is large enough to cause some degree of buckling in all wells except those with very high working fluid level. One way to relieve buckling is by placing the tubing in tensions. This can be done either by tension anchors or by anchoring the tubing and placing it in tension by surface pickup. Formulas and charts are given for proper tubing pickup. Since anchoring of tubing may also have other beneficial effects, such as increase of volumetric efficiency of the subsurface pump, the subject is now under study by a special API Mid-Continent District Subcommittee on "Tubing Tension in Pumping Wells."

Another way to avoid buckling is to use tail-pipe below the pump of sufficient weight to offset the buckling force. Formulas are also available for proper spacing of rod guides if their use is decided upon.

Remedial Measures. Wear of rods on tubing, whether brought about by buckling or other causes, is a serious operating problem. Many means for reducing this wear have been devised. Sucker-rod guides, from the wooden rod guides of 40 years ago, to the steel and nylon guides of today, are frequently applied. Rod and tubing rotators distribute the wear over larger areas, increasing the time interval between failures. More recently, unhardened couplings are being used on the theory that pulling the rods to replace a worn-out coupling is less expensive than pulling the tubing to replace a leaking tubing joint. If the wear is limited to the lowermost part of the tubing, buckling is probably the cause and remedial measures already mentioned can be taken.

During the last 3 or 4 years field evidence has shown that effects of rod-on-tubing wear can be minimized, and in some cases eliminated, by use of certain organic-type corrosion inhibitors. These inhibitors deposit an oily film on walls of tubing, with apparently high lubricating qualities. If the wear is purely a mechanical process, the film reduces the friction between rod and tubing. If the wear is of the abrasion-corrosion type the inhibitors also reduce the amount of abrasive corrosion products which would contribute to friction between rods and tubing.

On certain leases of the East Texas Field, rod-on-tubing wear became a severe problem with increased water content of the produced fluid. Use of inhibitors over a period of several years proved to be successful. Pulling expense due to rod-on-tubing wear has been reduced in some instances by as much as $1,500 per well per year. In certain portions of a field in northern Louisiana the well-pulling cost due to rod-on-tubing wear amounted to 40 to 50% of the total well-pulling expense. Tests, extending over a period of more than 3 years, showed inhibitors as most effective of different remedial measures tried. During the tests, untreated wells had a failure frequency four times as high as treated wells. Similar results have been obtained in Gulf Coast and Rocky Mountain fields.

Frequency of failures. The failures of sucker rods have been considered at length in this series because the problem of these failures is of economic importance. It affects both the operating cost and the investment in sucker-rod strings.

The first breaks in a new string of rods are usually the result of some hidden defects or of damage in-transit.[3] Later breaks are a result of any one of the causes previously discussed.

Eventually a point is reached in the useful life of a sucker-rod string at which the frequency of breaks, regardless of action taken, is of such size that the whole string must be replaced. The cost of pulling becomes prohibitive. Mathematical formulas have been worked out for the relationship between number of failures and days of service.[4]

References

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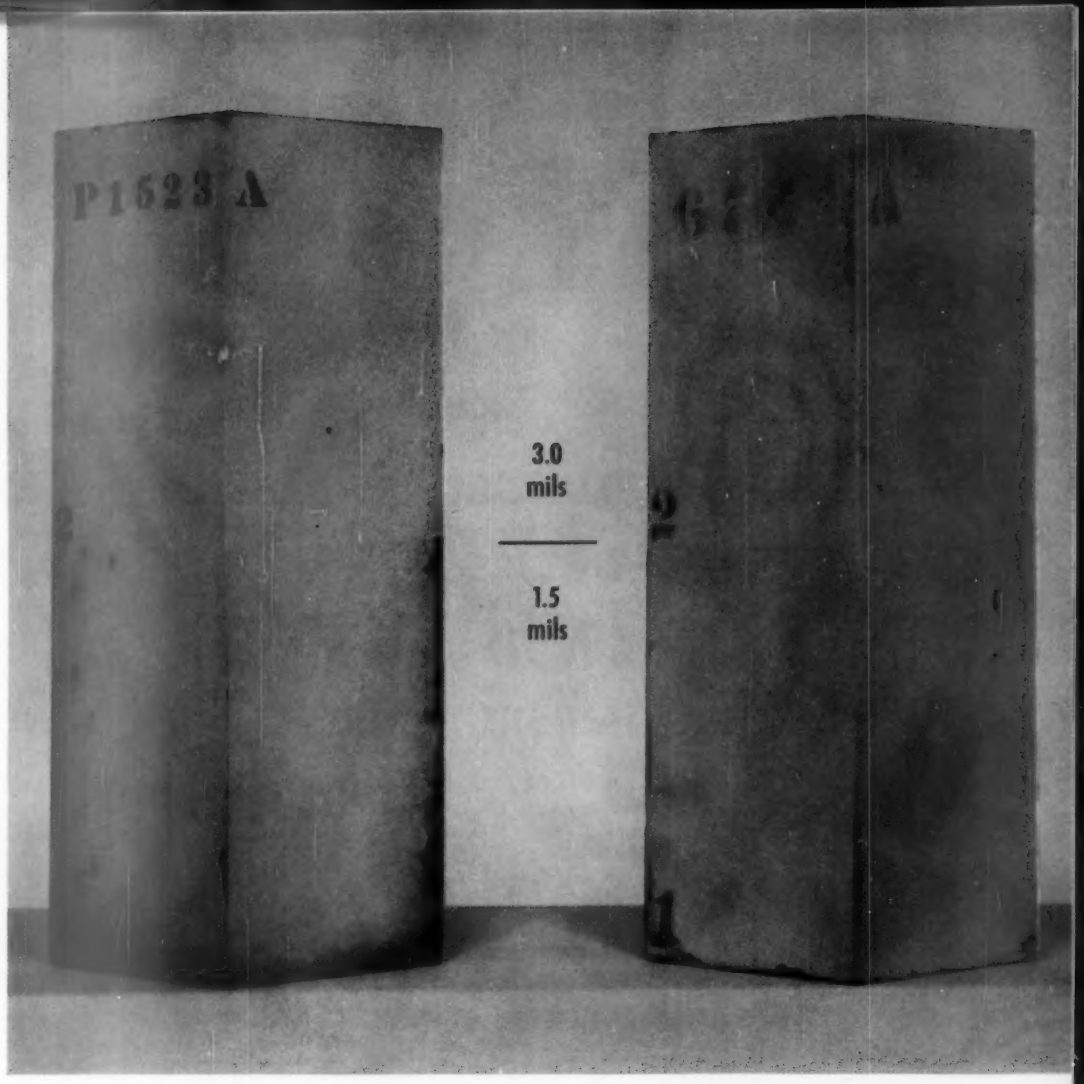

Never before such durable protection, never before such lasting appearance in metal protective paints.

Proof anti-corrosion finish paints made with M50® pigment give unique freedom from bilging

Compare ... for color ... the gray alkyd finishes on the two exposure test angles shown above.

By all previous concepts for anti-corrosion paints, the one on the left should be the darker, should show some splotchiness . . . even though the paint on both angles came out of the same can. That's because the angle on the left was exposed (four years, 45°S) to the heavily sulfur-laden industrial atmosphere of Perth Amboy, N. J., while the angle on the right was exposed (four years, 45°S) only to the normal atmosphere found at National Lead's Sayville, L. I. Test Station.

As you can see, the color difference . . . bilging . . . that you might expect from SO_2-caused precipitation simply has not developed in this paint made with *M50* pigment.

Combined with its unique resistance to discoloration by the chemicals found in industrial atmospheres, fused M50 basic lead silico chromate pigment demonstrates exceptional rust inhibitive action.

Now, with *M50* pigment, your regular paint suppliers can provide standard or deep-coat anti-corrosion primers, intermediates and finishes with superior rust inhibition, superior weather resistance, and excellent tintability. Paints that are more durable and don't bilge. The *M50* pigment is suitable for use with a wide variety of vehicles.

Color code paints look better longer, are more protective, too, with M50 pigment.

See, on the next page, more details... and how you can get these new, much more durable anti-corrosion paints.

M50 an **ancor** TRADEMARK *pigment development of*

National Lead Company

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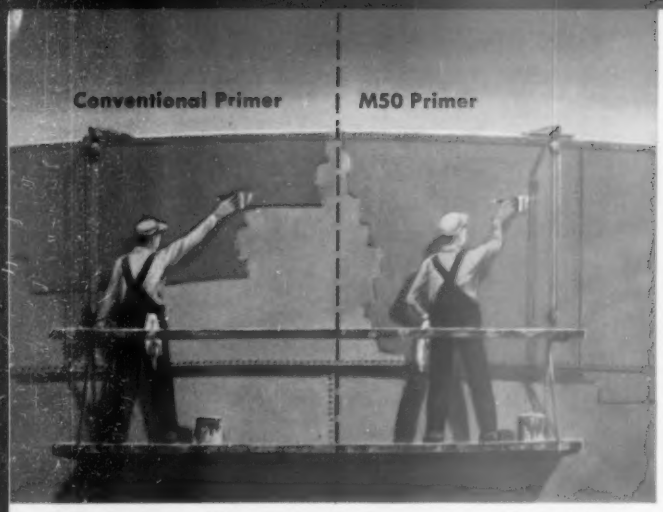
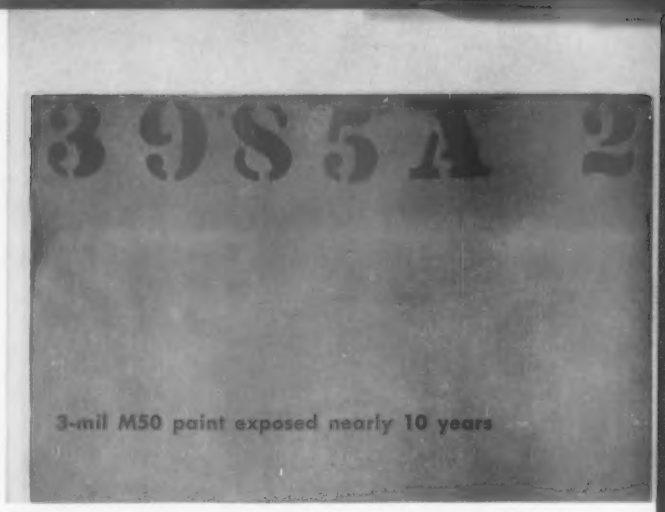


Weight for weight, anti-corrosion paints made with high-bulking M50 pigment cover 40% to 60% more steel.



Mil for mil, M50 paint films show better rust-inhibitive performance, lengthen the painting cycle interval.

Here's evidence M50 pigment paints reduce anti-corrosion maintenance painting costs two ways

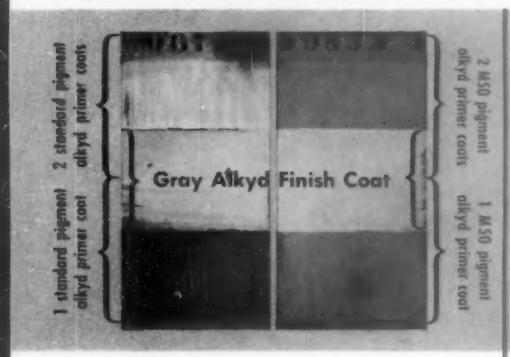
On the preceding page you have seen evidence that *M50* pigment paints are unique among anti-corrosion paints for anti-bilging properties. Exposure tests at National Lead's Sayville, L. I. Test Station have demonstrated these metal-protective paints are also unique for their anti-corrosion action, their weather-resistance, their color stability and many other performance characteristics.

Above you see evidence that *M50* pigment paints are equally unique in their ability to provide anti-corrosion maintenance painting economy. The illustration at left gives you a visual comparison between the coverage of a conventional anti-corrosion primer and an equal weight of an *M50* counterpart of this same primer (Fed. Spec. TT-P-86a, Type I). Clearly a given weight of *M50* pigment paint goes further.

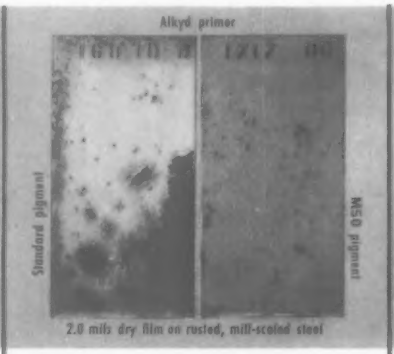
The picture at the right shows the condition of a 3-mil *M50* pigment *primer* exposed nearly 10 years *without a finish coat*. You can see that even in this severe test . . . an unprotected primer . . . anti-corrosion action is still being obtained. The repainting surface is still in good shape. Weather has not adversely affected protection. Imagine how many years of service you can anticipate from anti-corrosion *M50* finish coats applied over anti-corrosion *M50* primers in the normal or deep-coat systems!

Based on cost per sq ft per year, M50 pigment paints can greatly reduce the cost of your anti-corrosion maintenance painting.

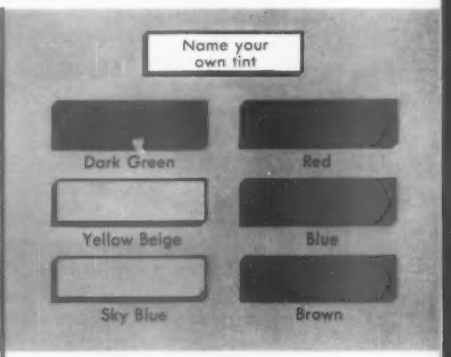
Why M50 Defense in Depth paints give anti-corrosion beyond all former concepts


2 standard pigment alkyd primer coats
2 M50 pigment alkyd primer coats
Gray Alkyd Finish Coat
1 standard pigment alkyd primer coat
1 M50 pigment alkyd primer coat

Exposed 9 years, 45°S. Each coat 1.5 mils
Proved corrosion and weather resistance



Exposed 45°S, 1 yr ind. atmos, 1 yr normal atmos.
Proved outstanding for film strength, durability



Colors above available in conventional and heavy-coat paints
A wide range of stable colors can be produced

Are you concerned with tank or structure maintenance painting in your firm? If so, you are invited: (1) to visit National Lead's Sayville, L.I. test station, where you will see the results of the 20 years research that lies behind the *M50* pigment particle and the more than 10 years of exposure testing that lies behind *M50* pigment Defense in Depth paints; (2) to send coupon below for National Lead booklet, "Defense in Depth" and typical *M50* tank paint specifications.

Next time you purchase, specify *M50* pigment paints. Any paint manufacturer can supply you.

M50 Defense in Depth

National Lead Company,
111 Broadway, New York 6, N. Y.

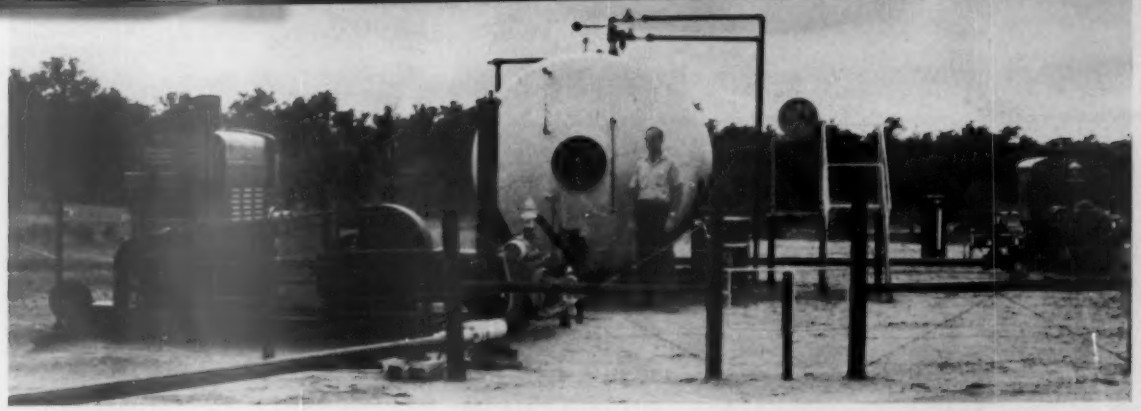
Gentlemen: Please send me the "Defense in Depth" booklet together with typical tank paint formulas and color chips that I can use in specifying M50-type tank paints.

Name_____ Title_____

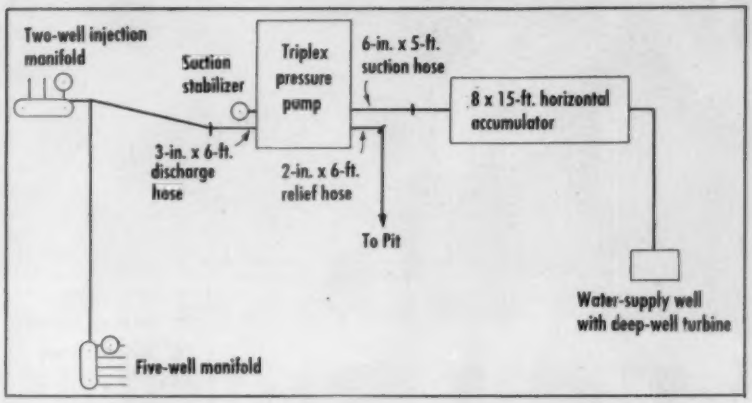
Firm or Dept._____

Address_____

City_____ State_____



CENTRAL water-handling system for the Prue sand unit pilot flood. Shown are the water supply pump and engine, right, the accumulator tank, center, and the triplex discharge pump engine, left. Inspecting the water level in the accumulator gage glass is J. D. Walters, district engineer for Sunray Mid-Continent's eastern Oklahoma production district.



SIMPLIFIED FLOW DIAGRAM shows all components of the water-injection system.

Low maintenance, high salvage value were considered in

Designing a water-injection system

BY W. B. BLEAKLEY
Production Editor

COST CUTTING was the target when Sunray Mid-Continent Oil Co. designed its pilot water flood in the Stroud Prue Sand unit.

Rubber-hose connections at the injection pump, and a single meter for a five-well water manifold contribute to the economical operation of this flood. Skid-mounted equipment throughout means easy transportation in case the engines and pumps are needed elsewhere.

Pilot operation. The entire Prue sand unit covers almost 3,000 acres in Creek and Lincoln counties, Oklahoma. Drilled on 10 to 40-acre spacing, there are 113 wells flowing, pumping, temporarily abandoned or shut in.

The pilot flood is made up of 19 producing wells and 7 injection wells. Old oil wells were converted for injection purposes. The injection pattern is a combination five-spot and line drive.

The field as a whole is approaching depletion by primary means, and Sunray engineers proposed a water flood to begin secondary recovery. They expect to recover as much additional oil by flooding as has been recovered so far by primary production.

Water supply. One water-supply well has been drilled for the pilot flood. It is 1,350 ft. deep, and is cased with 7-in. pipe cemented at 650 ft. The casing is slotted from 800 ft. to total depth.

A deep-well turbine pump is set at 450 ft. to supply about 1,800 bbl. per day of water with salinity of 150,000 p.p.m. and a pH of 5.5.

Water from the supply well goes directly to a horizontal accumulator tank, under pressure. This tank is designed to operate at 40 psi. and is internally coated with coal-tar epoxy resin to prevent corrosion.

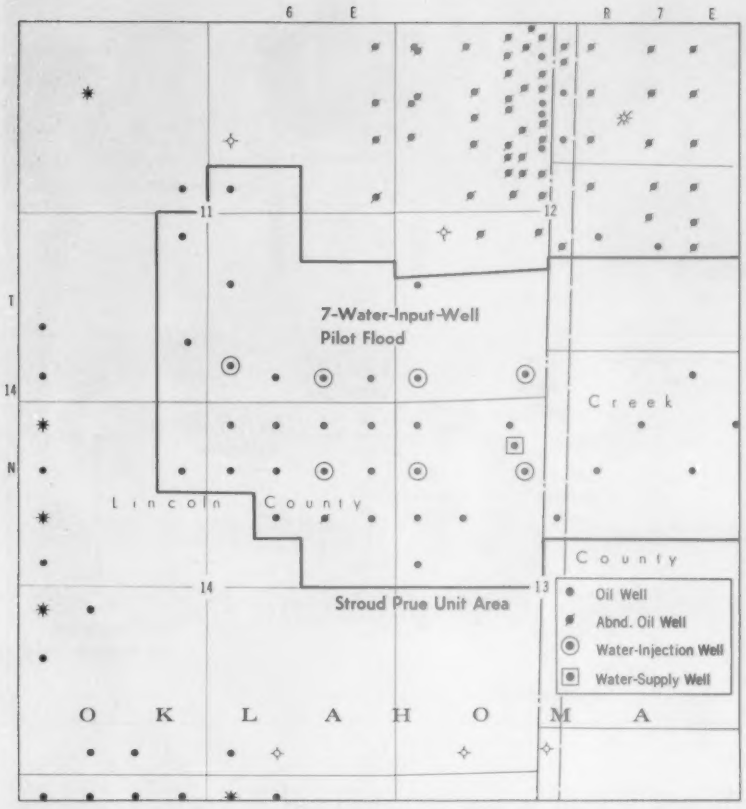
Corrosion inhibitor is added to the water as a further safeguard, but there is no further water treatment, not even filtration.

By maintaining pressure in the accumulator, the triplex injection pump is supercharged, in effect, with water at a pressure of 30 to 35 psi., the average accumulator pressure. This boosts the discharge pressure of the triplex without wasting fuel

Automatic controls. A liquid-level gage on the input side of the accumulator tank controls the operation of the water-supply well pump. If the level drops, the engine driving the pump is speeded up to increase the pump's output. If the level rises above a preset point, the engine is slowed down.

Another control device is connected to the throttle of the engine driving the triplex discharge pump. If the tank level drops, the engine speed is reduced until the water-supply pump can bring the level back to the normal operating point.

The triplex pump is protected against excessive discharge pressures and loss of water by pressure safety switches connected to the ignition system on the driving engine. There is an upper pressure-limit switch and a



LOCATION of the Prue sand unit pilot flood. All but a small portion on the eastern side is in Lincoln County, Oklahoma. The seven injection wells in the pilot system are converted oil wells. Only the water-supply well was drilled for the test. If this pilot operation proves successful, the flood will be extended to cover the rest of the unit to the east (not shown on map).

lower pressure-limit switch. Either one will shut down the engine in case of extremes of pressure, high or low.

Money-saving manifold. Distribution of water to some of the injection wells is made through a five-well manifold. Unique feature of this manifold is that there is only one meter. The piping is arranged so that one well at a time can be put on test through the meter. This reduces the cost of the installation by the amount of four additional meters.

The meter is a positive-displacement type. Short period tests have been made, extrapolated to 24 hours, and compared with actual metered 24-hour tests. Results have checked favorably, usually within 1 or 2 bbl. per day, thus justifying the engineers' choice of design.

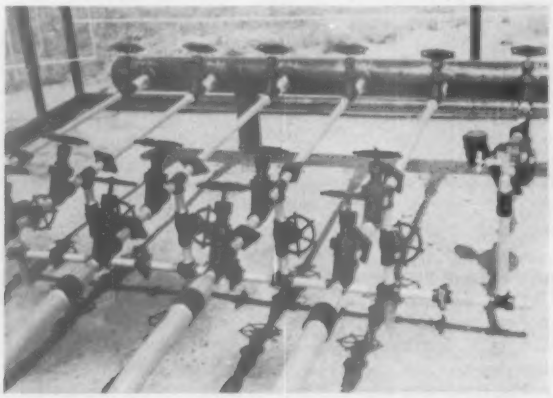
System protected. Sunray engineers have incorporated several unique features into the system to eliminate some maintenance problems and to protect the equipment.

Both suction and discharge lines on the triplex pump have a section of heavy rubber hose installed. These are commercially made hose sections, similar to rotary hose. They serve a dual purpose: (1) They can be quickly and easily disconnected in case of a change in equipment, or in case the entire unit is to be moved to another location, and (2) they absorb all engine vibrations so that the couplings used in the water-distribution line will not spring leaks.

Sunray engineers consider these hose connections to be a necessary part of their system. All equipment is skid-mounted for easy removal if the pilot flood doesn't prove itself, or if another location needs it. The water-distribution line is coupled instead of welded for the same reason. The savings in welding costs are substantial and they are made possible through the use of the rubber hose.

The water-supply well pump and the triplex pump are both driven by gas engines. Oil levels in the crank cases are maintained constant through an automatic setup that feeds lubricating oil into the engines as soon as the level drops below a predetermined point.

PUMP SUCTION and discharge go through flexible lines similar to rotary hose. This cuts out vibration that might weaken the coupled joints in distribution line. Pump can be quickly disconnected for replacement or for moving to another location.



THIS MANIFOLD handles water for five injection wells. Only one meter is needed, right, as water for any well can be diverted through the meter run for gaging input rate. Cost of four meters is saved with this arrangement. Meter is a positive-displacement type.

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REDUCES PREMATURE SETTING Casing drag and junk impact are transmitted through the mandrel shoulder directly to tubing string.

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REQUIRES LESS DRILLING TO REMOVE Top slips are first part drilled. After drilling through them, packer can be fished out, or ½ to ⅔ of packer can be drilled and rest pushed to bottom of hole.

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TYPE AG — No flapper valve . . has guide body in place of junk pusher

TYPE AT — Has integral tail pipe connection . . no flapper valve

TYPE W — Small diameter . . wire line set only

TYPE AR — Small mandrel ID . . with flapper valve

TYPE ANR — Small mandrel ID . . no flapper valve

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2-pen Foxboro Dynalog Recorders chart both upstream interface profile and station profile on Phillips' two pipelines. Upstream record allows operator to select best cut point well in advance of interface's arrival.

Automatic Foxboro interface detection system eliminates guesswork at Phillips pipeline terminal

operators get interface profiles in advance...know exactly when to switch tanks

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This unique Foxboro system is based on the fact that even slight differences in grades or brands of petroleum products have measurably different dielectric constants. Sensitive Capacity Dynalog* Recorders measure this difference, both at the pipeline delivery station, and at a point 3 miles upstream. Foxboro Teletax* Telemetering brings the two measurements together on a single chart at the delivery point.

From the shape of the upstream record, the operator selects the best cut point and sets his index. When station interface record matches index, switch-over is made.

Phillips dispatchers find their Foxboro system eliminates sampling and guesswork — cuts product contamination to a new minimum. It can do the same for you. Ask your Foxboro Field Engineer for full details, or write for Bulletin 20-11. The Foxboro Company, 6010 Neponset Ave., Foxboro, Mass.

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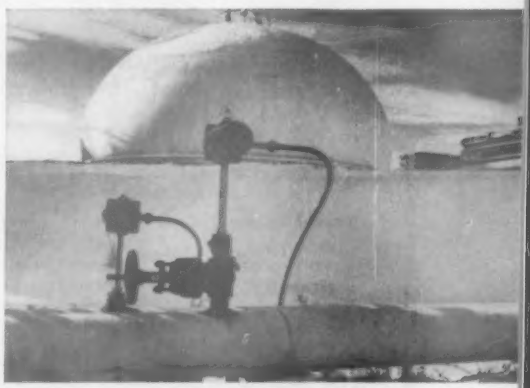

Capacity probes at upstream measuring point, and at terminal (shown above) measure dielectric constant of product passing through pipeline. Upstream measuring station is unattended — profile is telemetered to Dynalog Recorder at terminal.

FOXBORO

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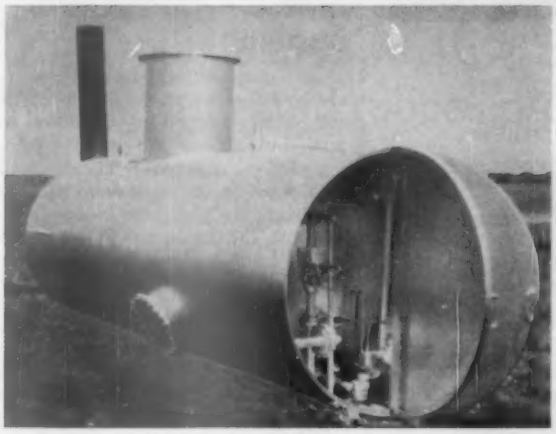
▶ ▶ ▶ New Equipment Section

This week's SHOWCASE features . . .

High-resolution mass spectrometer

. . . permits exploration into a variety of materials - research problems, including structural studies of greases and polymers for better petroleum and petrochemical products, according to the maker. The Type 21-110 instrument uses a double - focusing mass resolving system of the Mattauch-Herzog type to obtain high resolution. In this system, a tandem arrangement of electric and magnetic fields focuses ions having the same mass but differing initial velocities and directions. Mass range of the instrument is 2 to 2,000. Source: **Consolidated Electrodynamics Corp., 360 Sierra Marde Villa, Pasadena, Calif.**



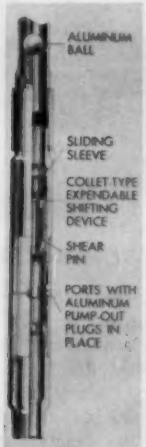
New treater for tough emulsions

. . . recently announced is claimed to cost less to buy and install than older types of treater yet to be able to treat the toughest emulsions. The treater is expected to be particularly useful for water flood projects.

Called a Treat-Pak, it operates as a pressure treater with or without gas and automatically changes from gas to hydraulic delivery without manual attention, the maker says.

The maker claims a new concept in furnace design is used which minimizes firetube coking, corrosion, and burn-out. The treater is designed as a cold-weather treater without internal piping. The piping and controls are housed in a heated enclosure which is accessible through two doors. The unit is skid-mounted with controls and piping factory-assembled. Source: **Sauder Tank Co., Inc., 220 Weaver, Emporia, Kan.**

Safer method for completion



. . . of high - pressure wells is claimed for a new tool now on the market, the Type A sliding side-door. The tool is said to permit blowout preventers to be removed and the tree "nippled-up" before circulating the well to displace drilling fluids. Another advantage claimed for the tool is that it offers a way to eliminate the cost of a standby wire-line service unit and the problems involved with wire-line operations in heavily weighted fluids.

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Features include aluminum pump-out plugs in the ports and an expendable aluminum collet type of shifting device made up in the sleeve. Source: **Otis Engineering Corp., Box 35206, Dallas 35, Tex.**

●

Gear-operated combination valve

. . . in an 8-in. size is available. The Plugaroo valve is a full-opening non-lubricated plug and check valve which promises to prove valuable for transmission lines carrying butane, propane, and natural gasoline.

The full opening permits passage of scrapers and ball markers. The worm gear is fully enclosed. The valve is rated at 1,440 psi. w.p. and will withstand temperatures from —120° up to 600° F., the maker says.

The valve is available in steel, semi-steel, stainless steel, and aluminum-bronze. It is fabricated to meet API-ASA face-to-face dimensions for all threaded, flanged, hammer-union, beveled, and grooved ends. Seals may be Teflon or synthetic rubber. Source: **Frank Wheatley Corp., 125 W. First, Tulsa, Okla.**

●

Why MID-AMERICA chose Frank Wheatley's PLUGAROO!

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- Available with Teflon, Vitone "A", or Synthetic Rubber Seals in steel, semi-steel, aluminum bronze, and stainless steel from Series 15 to 90.

System

. . . to monitor remote stations recently developed is claimed to permit completely unattended operation of pumping stations and other pipeline installations. The maker claims the B-1000 series scanning system provides extremely reliable continuous scanning of all functions by electronic means without the use of relays, stepping switches, motor-driven communators, or rotating switches.

It is said to use a form of time-division multiplexing which codes each function and repeats it continuously at rates up to 3,000 bits per second. Source: **Lynch Communication Systems', Inc., 695 Bryant, San Francisco 7, Calif.**

●

Audible reports of meter readings

. . . in pipeline systems can reportedly be obtained with a new device on the market called a digital-to-audio translater - accumulator (D A T A). The

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SHOWCASE . . .

New Equipment

unit weighs 26 lb. and can be installed in less than 2 hours, the maker claims.

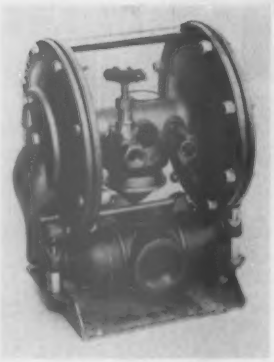
Operating range is said to be practically unlimited and almost any medium can be used to transmit a message, including regular telephone facilities. The electromechanical device was developed by Marathon Pipe Line Co. It is claimed to be highly reliable, practically error-free, and economical.

To obtain a spoken report with the device from a distant point, a dispatcher merely dials a number and then listens to the audible flowmeter reading coming in over the telephone or microwave system. The unit operates from a 115-volt electrical connection and has built-in standby batteries to operate it should power fail. Source: **Continental Technical Service, Inc., 19 W. 4th St., Dayton, Ohio.**

•

Gas-operated utility pump

. . . being marketed can be powered by air or other gas at pressures from 5 to 100 psi. The maker claims the pump provides closely controlled discharge volumes from 1 to 60 g.p.m.



Using a double-acting diaphragm design, the pump is said to easily handle solvents, slurries, and liquids containing solids with a ¼-in. diameter. Discharge pressures from vacuum to 60 psi. are possible. Weighing 70 lb., the pump comes complete with a 2-in. suction and discharge, air-pressure relief valve, carrying handle, steel base plate, and air-reduction control valve. Source: **Texstream Corp., Box 9127, Houston, Tex.**

•

Newest domestic gas meter

. . . features a V-shaped design and comes with a capacity of 250 cu. ft. per hour. The meter is claimed to weigh less and to be smaller than any other meter of the same capacity. The housing of the V-250 meter is of die-cast aluminum.

According to the maker, the V-shape allows the index to be included in the boundaries of the meter housing. The V-shape also provides easy access for adjustments and permits simplification of the measuring mechanism.

The measuring mechanism contains only six moving units and requires only six bearings. The two bellows type of diaphragms are located at a

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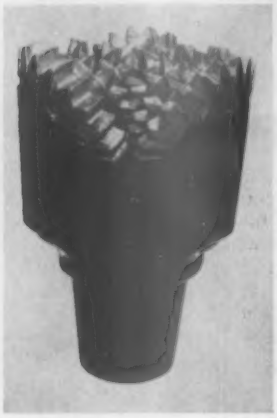
60° angle to each other. The meter measures 11⅛ in. high, 10¾ in. wide at the front, and 8⅞ in. from front to rear. The distance between connections is 6 in. Source: **Arkla Meter Div. of Arkla Air Conditioning Corp., Russelville, Ark.**

●



New bit

. . . promises fast drilling of medium-hard formations. According to the maker, the VH2-G formation-type bit is designed for drilling in shale, hard anhydrites, and limestone. It comes in three sizes: 7⅞, 8¾, and 9 in. Bit features include chiseled teeth with tungsten-carbide reinforcing on the gage. Source: **Varel Mfg. Co., 9230 Denton Dr., Dallas, Tex.**

●

New mixer

. . . for crude tanks is available which you can drive from the power takeoff of a diesel tractor to resuspend paraffin. Applicable to tank sizes from 5,000 to 200,000 bbl., you may find it particularly useful where electric power is not economically available or where operation is intermittent at long intervals.

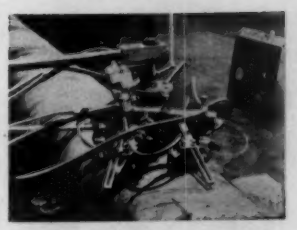
One feature of the Vari-Angle mixer is that you can use one tractor for the power drive for a number of tanks. The maker claims that investment costs have been reduced as much as 75% and operating costs have been reduced as much as 50% through use of the equipment when compared with electric-driven equipment. Source: **Jensen Engineering Co., 5354 S. Garnet Rd., Tulsa, Okla.**

●

Ultrasonic pipe-testing system

. . . is now available for use with the trailer-mounted mobile Driam spiral pipe-making machine. The testing system is said to permit complete nondestructive testing of the pipe as it is produced.

In the system, four heads are used



to beam the ultrasonic waves so that echoes from pipe defects on the center or to the right or left of the weld seam will be recorded. Paint is then sprayed automatically on defective areas to permit visual inspection or X-ray of defects. Source: **Driam Corp., Manitowoc, Wis.**

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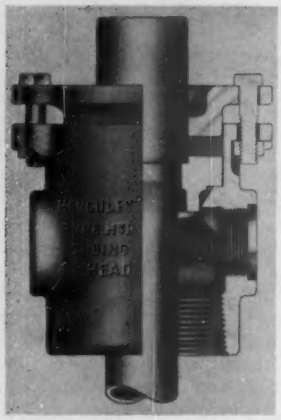

Collar-suspension tubing head

. . . comes in three outside diameters, 3½, 4½, and 5½ in., for use on tubingless completions, water floods, and shallow pumping wells of 2,500-ft. depth or less. Test pressure: 500 psi. Maximum recommended load: 30,000 lb.

An advantage claimed for the Type HSR tubing head is that well connections do not have to be disturbed to repack it. Source: **Hercules Tool Co., Box 286, Tulsa, Okla.**

Plane gives better visibility

. . . for passengers than older models, the maker claims, as the envelope size of the nacelles has been reduced. The new Commander 500B plane is a 6-to-7 passenger, twin-engine unit powered by two 290-hp. fuel-injection engines.

The plane is said to be relatively quiet, both inside and outside. This is achieved in part by placing the exhaust ports on top of the engines. This sends the exhaust and its resulting noise out over the top and away from the plane. Also contributing to quietness is a double-wall metal structure for the engine cowling. Source: **Aero Design & Engineering Co., Bethany, Okla.**

Subsurface pump

. . . for slim-hole wells comes in a full range of slim-hole completion sizes which is said to allow oil producers to plan slim-hole programs with the assurance that subsurface pumps are available in the required size. The Little Squirt pump comes in four rod-pump sizes. It can be run in either single or multiple-string wells with 1¼ or 1½-in. tubing, the maker says. Source: **Harbison-Fischer Mfg. Co., Box 2477, Fort Worth, Tex.**

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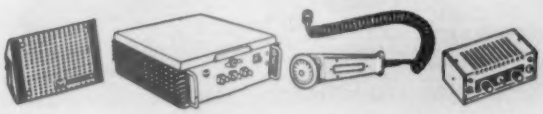

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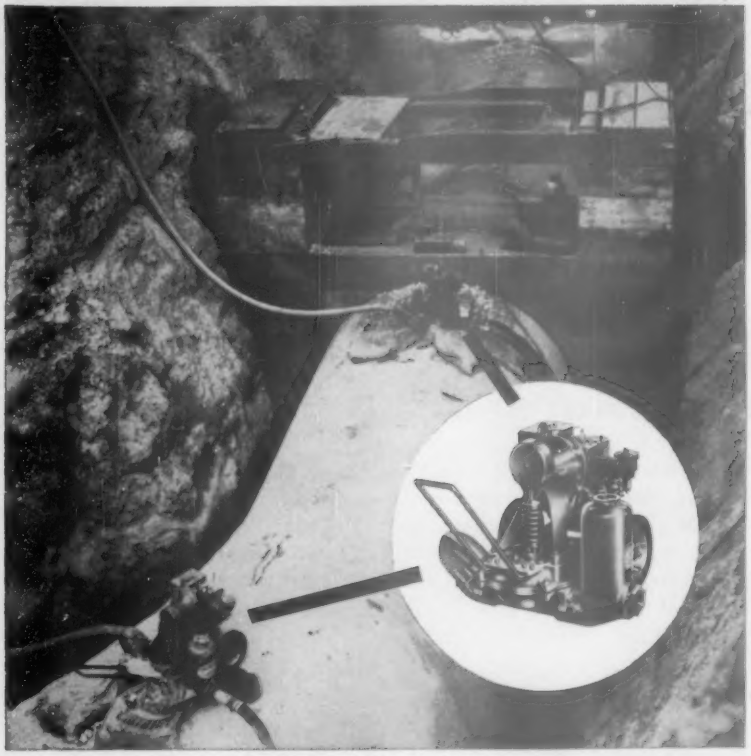
Ball valve

. . . needs no lubricant to obtain a tight seal, according to the maker. The recently developed valve has no bonnets, gaskets, or joints; consequently, troubles caused by such parts are eliminated. Each operation of the valve partially rotates the seats. Compared to older valves, the ball valve is said to be more compact and lighterweight, making it easier to install either in a ditch or overhead.

Potential applications exist in pipelines, refineries, and drilling and production equipment. The valve can be installed in any convenient position, without regard to top or bottom. All types of valve operators can be used with it, the maker says. For high temperature or corrosive service, the valve can be obtained of special materials. The valve presently comes in sizes from 2 to 36 in. for ASA Classes 150 through 600 lb. Source: **Cameron Iron Works, Inc., Box 1212, Houston, Tex.**

57 DIAPHRAGM PUMPS ON THIS JOB...AND 47 ARE GORMAN-RUPP



The Brea (California) pipeline job consists of 14 miles of 96" cement-coated steel pipe. Diaphragm pumps were selected because they can be easily moved from bell joint as the welders progress. Contractors: Morrison-Knudsen, Inc. and Macco Corp. of Los Angeles.

Gorman-Rupp Diaphragm pumps are by far the favorite of contractors. These exclusive features show why: diaphragm drive rod spring-cushioned on down-stroke; suction accumulator for smooth pumping flow; antifriction, helical-ground gears and bearings operate in oil; one-man handling, engine-driven 3" pump only 120 lbs., job-to-job.

Isn't it time you tried a Gorman-Rupp Diaphragm pump?

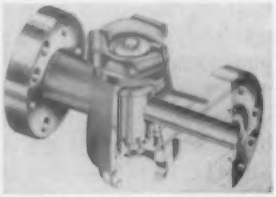
THE GORMAN-RUPP COMPANY
305 Bowman Street • Mansfield, Ohio
Gorman-Rupp of Canada, Ltd., St. Thomas, Ontario

Gas accumulation

. . . can be monitored continuously and potential explosions thus prevented with a new instrument now on the market called a Detectogas monitor, claims the maker. The instrument is claimed to sense changes in air density caused by gas accumulations, yet to be unaffected by changes in humidity, pressure, or temperature. The instrument measures 15½ by 7 by 10¼ in. and weighs about 10 lb. Source: **Detectogas Instruments, Inc., 3110 Eastside, Houston, Tex.**

Platinum-reforming catalyst

. . . is available from an Amsterdam manufacturer which is said to show excellent activity and maintenance stability. According to the maker, the Types CK-303 and 306 catalysts can be used in any type of platinum reforming unit under high as well as low-pressure operating conditions, giving improved yields of high-octane gasoline. The catalysts are reported to be fully regenerable. Source: **Nederlandsch Verkoopkantoor Voor Chemische Producten N.V., Postbus 4038, Amsterdam, Netherlands.**

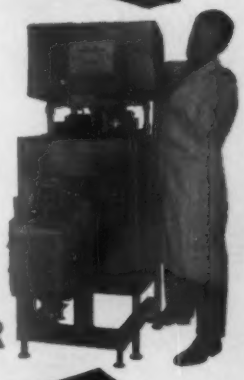


Plug valve

. . . for well-service work as well as production, drilling, and refinery operations now comes with flanged ends as well as with threaded ends as previously marketed. One advantage cited for the Lo-Torq valve is that the plug and inserts which are subject to the most wear may be replaced easily without removing the valve from a manifold or line. Source: **Halliburton Co., Duncan, Okla.**

For blending crude oil products . . .

NEW SINCLAIR -CENCO GRAVITOMETER



Blends crude oil products and other liquids to constant outgoing gravity. Records outgoing gravity to 60°F regardless of flowing liquid temperature. Response time, 30-35 seconds. Manufactured and sold by Cenco under license by Sinclair Research Labs, Inc. Write for Booklet 314.

No. 35090 Each $3750.00

cenco®

REFINERY SUPPLY CO.

A Subsidiary of Central Scientific Co.

621 East 4th Street • Tulsa 20, Oklahoma
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NOW . . . A Complete line of

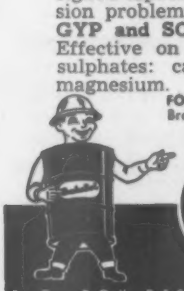
BrakeSol®

OIL FIELD CHEMICALS

Developed exclusively for solving particular problems in the petroleum industry.

P.T.C. . . . The original Paraffin Treating Chemical. Holds paraffin in suspension from formation to refinery.
DEMULSIFIER D-7 . . . Universal Treating Compound. Gives cleaner oil with less heat resulting in a BETTER PRICE.
STIM FORM® . . . Clean Well Bore! Designed to remove restrictions in perforations . . . face of pay . . . formations.
CORROSION INHIBITOR CI-123 . . . Designed especially for control of oil field corrosion problems.
GYP and SCALE TREATMENT GS-20 . . . Effective on these types of carbonates and sulphates: calcium, strontium, barium and magnesium.

FOR INFORMATION . . . Contact Supply Store Brakesol Treating Engineer or write direct!



BrakeSol INC.
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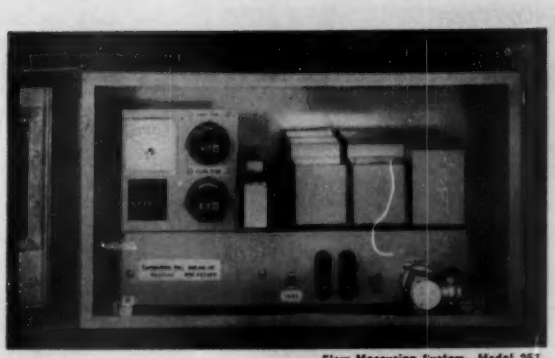
P. O. BOX 9506 • OKLAHOMA CITY, OKLA.
EXPORT DISTRIBUTOR: THE NATIONAL SUPPLY CO. EXPORT DIVISION



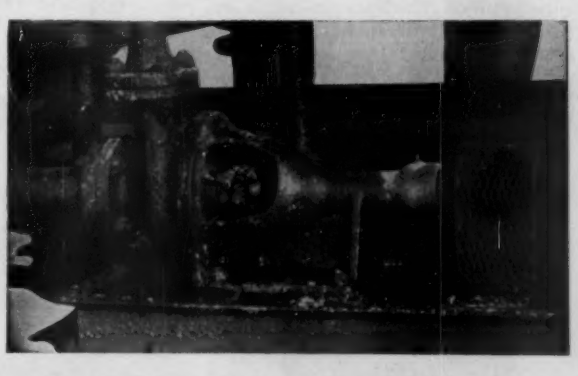
Flow Measuring System—Model 257

MEETS THE DEMAND FOR ACCURATE FLOW MEASUREMENT AND/OR CONTROL

- Gas or liquid
- Steady or intermittent flow
- Wide range
- Direct reading of volumes
- Accessories to make permanent record
- Low installation cost, low operating cost
- Plug-in components

To improve accuracy, to simplify operations, to lower costs, with high performance orifice flow measuring systems, contact

COMPUTERS, INCORPORATED
3407 South Shepherd Drive • Houston 6, Texas



CORROSION CAN'T K. O. THIS CENTRIFUGAL PUMP!

***It's an* AMPCO®**

Ampco protective features include: *Wear rings*—to save the casing; *Shaft sleeves*—to eliminate worn shafts. Repair and maintenance cost less — downtime is reduced.

Available *from stock* in stainless steel, Ampco metal, and Illium "G." Pumps with elastomer or rubber linings also available. See your Ampco Pump Distributor. Or write for Bulletin P-3b.

AMPCO®

AMPCO METAL, INC. P-47
DEPT. 1691, MILWAUKEE 46, WIS.
WEST COAST DIV. HUNTINGTON PARK, CALIF.
SOUTHWEST DIV. GARLAND (DALLAS COUNTY), TEXAS

SHOWCASE . . .

New Equipment

Probe

. . . to measure temperature of such nonrigid materials as chemicals and plastics has a retractable through-surface probe tip for measuring temperature. A sheath protects the probe's needle tip when not in use.

To take temperature readings, you turn a dial selector on the probe which permits you to insert the tip into nonrigid masses to the desired depth to obtain a temperature reading. The maker reports that the H20AF probes are watertight and abrasionproof. They are for use with Atkins Thermophil instruments covering the temperature range from −150 to 410° F. on multiple scales. Source: **Atkins Technical, Inc., 1276 W. 3rd, Cleveland, Ohio.**

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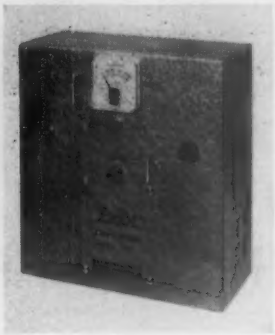


Charger

. . . operates at two rates, a high rate for recharging discharged batteries and a low rate for maintaining a charge by trickle or float charging. You can adjust the low rate to provide for steady system loads and battery floating currents.

The Hi-Lo rectifier type of charger can be used with 6 to 60-cell batteries such as those used to supply standby or intermittent power for emergency lighting, process equipment, engine starting, and safety alarms. It operates on either 110 or 220-volt single-phase, 60 c.p.s. a.c. power and comes in four models. Source: **Exide Industrial Div., Electric Storage Battery Co., Rising Sun and Adams Ave., Philadelphia 20, Pa.**

Tank lining in 48-in. wide rolls

. . . is now being produced. You can use it to obtain a corrosion-resistant lining for tanks, vessels, and other equipment operating in a moderate-to-severe corrosive environment. The Penton lining, a chlorinated polyether polymer, can be applied to both new equipment and existing equipment in the field, according to the maker. Two sheet thicknesses are available, 0.040 and 0.062 in. The heavier gage material is designed for conditions of severe abrasion. Also available are welding rods, seamers, and corner strips for installing the lining. Source: **National Vulcanized Fibre Co., 1060 Beech, Wilmington 99, Del.**

Spray coating to protect metal

. . . wood, and concrete by providing a corrosion-resistant surface is available along with a spray gun unit specially designed to apply the coating. The coating is a homogeneous mixture of the maker's Fiberglas Flake, resin, fillers, accelerator, and pigment (if desired). Potential uses include chemical and oil storage tanks, jackets for stack insulation, ducting of chemical materials, and concrete sewer lines. Other possible uses include as a liner for concrete floors, as a water sealant for concrete block and slab walls, and as a lining for tank cars. Source: **Owens-Corning Fiberglas Corp., 717 5th Ave., New York, N. Y.**

CHECK THESE

FACTS

on the World's Newest, All-In-One Coupling

for making hose connections at dockside, shipboard, storage depots, off-shore rigs, bunkering stations, and with road and rail tankers, etc.*

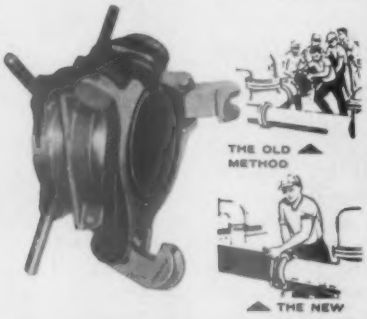
✔ **SAFE** Eliminates gaskets, drifts and wrenches and the dangers associated with their use.

✔ **EASY TO OPERATE** Just hook up and rotate the handle.

✔ **VERSATILE** Can be easily adjusted to accommodate the variations found in foreign counterparts of American flanges; can be attached to the hose either by screwing directly to the threaded nipple in the hose or by bolting to an existing hose flange.

✔ **POSITIVE SEALING** The seal is automatically made as the flanges are brought together and even on the roughest surfaces, the *higher* the pressure, the *tighter* the seal.

✔ **POSITIVE LOCKING** The coupling is locked whenever handle rotation is stopped.



**To check ALL the facts on construction and operation, request on your letterhead: "QD-16 Coupling Brochure"*

Flight Refueling, Inc.
COMMERCIAL PRODUCTS SECTION
BOX 1701 BALTIMORE 3, MARYLAND

SHOWCASE . . .

New Literature

Flexible-tubing facts

. . . are presented in a new manual which provides a description of the varied forms, major advantages, and uses of flexible tubing. It outlines new methods for handling air, liquids, and light solids with nonmetallic tubing. Source: **Flexible Tubing Corp., Guilford 2, Conn.**

Liquid-solids

. . . separation equipment for chemical and metallurgical processing is described in a new four-page condensed catalog recently released. Catalog FP-1003 contains brief descriptions and pictures of equipment for vacuum and pressure filtration, for sedimentation and flotation clarification, and water and trade-wastes treatment equipment. Source: **Eimco Corp., Box 300, Salt Lake City 10.**

Mass flowmeter

. . . of the gyro-integrating type is discussed in new two-page Bulletin GEZ-3025. It gives ratings and typical applications while including a discussion of benefits derived from converting from volumetric to mass flow measurement in various applications. Source: **General Electric Co., Schenectady 5, N. Y.**

Well-swabbing concept

. . . is featured in an eight-page brochure which describes Swabstix flow inducers. The publication, yours for the asking, tells how and where the flow inducers are effectively applied, and contains performance data on a number of wells. Source: **Tretolite Co., 369 Marshall Ave., St. Louis 19, Mo.**

Special antitrust concentrate

. . . known as SARC is the topic of an eight-page brochure just published. It defines the product as a blend of selected chemicals and special ingredients which inhibit rust and corrosion in equipment-cooling systems through the formation of a thin, protective film on metallic surfaces.

The brochure contains sections on the functions and problems of modern-day cooling systems, the value of using rust inhibitors, the year-round protection afforded by SARC (both as

check the valve

that doesn't chatter

Check the Daniel Piston Controlled Check Valve for quiet efficiency in preventing flow reversal. Choose from stock in sizes and types covering a wide range of both compressible and non-compressible fluid services. Patented, free-floating piston design eliminates chattering and minimizes pulsation. Available in carbon or cast alloy steels with stainless trim, or with hard-faced internals for mud-line service. Up to 10,000 lbs. A.S.A. ratings.

DANIEL
ORIFICE FITTING COMPANY
INCORPORATED
Houston, Texas
P. O. Box 19097
Homestead 5-3451
Los Angeles, California
3352 Union Pacific Ave.
Allgeier 9-9205
Write for Daniel Catalog Section "H"

a supplement to antifreeze and as a constant protective agent during hot-weather operations), and directions on when and how to use the product. Source: **Lubrication Engineers, Inc., 2809 Race St., Fort Worth, Tex.**

Refinery-stream corrosion

. . . and fouling problems are discussed in a newly offered technical file, consisting of five bulletins that deal with product and process research. The first bulletin, concerned with a general discussion of corrosion control, gives information on what makes inhibitors work and how corrosion programs may be evaluated.

Another covers technical data on a high molecular weight, polar, organic liquid corrosion inhibitor that also has detergent properties. The third publication is concerned with data on an ammonia-compatible, water-soluble inhibitor. Another describes an organic, film-forming agent to control corrosion in pipelines and equipment used in handling refined petroleum products.

The last bulletin discusses a high-molecular-weight, polar, organic anti-foulant designed to stabilize and disperse deposit-forming materials in refinery hydrocarbons. Source: **Nalco Chemical Co., 6216 W. 66th Pl., Chicago 38, Ill.**

MID-AMERICA

BUILDS FOR ENDURANCE

Mid-America Pipeline Company's new line will carry LPG all the way from the West Texas and New Mexico area to Minnesota and Wisconsin—2,200 miles of pipe. A big job of construction. Big investment in money too! Pipelines must be built to last.

That's why Reilly Hot Service Enamel with HS X-10 Primer and Reilly Intermediate Enamel with Q. D. Primer, were specified as coatings for a portion of the Mid-America system to lend lifelong protection against corrosion to the new line. Coal Tar Enamels are the engineering materials of choice where endurance of protection against corrosion is a design requirement.

Reilly COAL TAR PRODUCTS

ARMED Protective Coatings

REILLY TAR & CHEMICAL CORP.

1615 MERCHANTS BANK BUILDING
INDIANAPOLIS 4, INDIANA

Procedures

. . . of Contract Research for Industry is the title of a new six-page folder which describes in a step-by-step manner the relationship existing between a client and the research institute. This begins with the initial meeting of the two parties and progresses beyond the successful completion of a specific project.

Phases of this relationship discussed include the preliminary conferences between the client and the research institute that precede the initiation of a research project; conferences among institute specialists to define the research objective and evaluate possible approaches; the contractual agreement between the institute and the client; actual conduct of the research; reports to the client while research is in progress; and the presentation of final results, as well as followup services. Source: **Battelle Memorial Institute, 505 King Ave., Columbus 1, Ohio.**

Industrial insulation

. . . brochure features two new products—calcium silicate and mineral wool block—for temperatures up to 1,900° F. Also introduced is Careytemp, another industrial insulation offering heat resistance in a wide range up to 1,600° F. It's said to offer exceptional resistance to moisture, acid, and corrosion with practically no linear shrinkage. Source: **Philip Carey Mfg. Co., 320 S. Wayne Ave., Cincinnati 15.**

Tubing-joint specifications

. . . and dimensions are given in a new pocket-size data sheet on the new SPA 190 "IJ" tubing joint. The folder describes the integral joint designed for use in slim hole or multiple completion in shallow to medium-depth wells. Source: **Atlas Pipe Inc., 511 First City National Bank Bldg., Houston 2, Tex.**

Aluminum welding

. . . fittings called Traceline, for the installation of extruded aluminum integral steam-traced piping, are described in Bulletin TL-1 just issued. Drawings illustrate 90° and 45° bends, tees, crosses, 45° laterals, eccentric reducers, and sole plates manufactured in seven sizes. Source: **Alcast Fittings, Box 151, Claymont, Del.**

(Continued on page 316)

How good is your cement job?

The New Schlumberger Cement Bond Log gives you the answer

For the first time, a logging device is available which goes far beyond mere detection of the presence of cement.

You can now record the effectiveness of cementation . . . the new Schlumberger Cement Bond Log points clearly to channeling, uncemented intervals, or poor casing bond.

Call any Schlumberger office for more details on this new service or write for complete information.

THE EYES OF THE OIL INDUSTRY

SCHLUMBERGER

seal

CONSOLIDATED SAFETY RELIEF VALVE'S Sealing Bellows protects against damage from contaminants, corrosion, or viscous fluids

saves

Consolidated Safety Relief Valves are available in both Balanced Bellows and Standard designs. The Standard type has an eductor tube that effectively removes bonnet pressure.

Balanced Bellows Type Consolidated Safety Relief Valves have a durable, two-ply stainless steel Sealing Bellows that isolates and protects working parts from destructive elements in the lading fluid.

The bellows is balanced with the seating surface. Even with superimposed back pressure in the relieving system, valve performance is consistently stable and dependable. The bellows does not affect the high capacity of the valve, nor does it require change in set pressure. Even the blowdown adjustments are limited.

Additionally, Consolidated Safety Relief Valves now offer a no-leak tightness maintained by a resilient "O" Ring Seat Seal retained in the valve disc. This Seal assures tightness at operating pressures far closer to set pressure than with metal-to-metal seats alone, yet does not carry the seat load imposed by the spring. The Seal also takes piping strains much better than all-metal seating.

The Sealing Bellows and "O" Ring Seat Seal are typical of the extra quality built into Consolidated Safety Relief Valves to assure absolute protection for personnel and plant. These fine features plus flat seating and single ring construction also eliminate many maintenance problems and costs. Write for Catalog 1900 and Bulletin 1940.

MANNING MAXWELL & MOORE INC. M&M TRADE MARK

CONSOLIDATED SAFETY RELIEF VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

Valve Division • Watertown, Massachusetts

In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

▶▶▶ Equipment Men Notes

Union Wire Rope Co. names

. . . two new sales representatives. John M. Fry will cover western Oklahoma and the Texas Panhandle working out of Oklahoma City. He will report to G. E. Giese, branch manager.

Lloyd C. Smith III will cover Virginia, along with parts of Kentucky and West Virginia while working out of Charleston, W. Va. He will report to District Manager R. D. Tripp at the Ashland, Ky., office.

PIPE-INSPECTION SERVICES including magnetic and electronic-type inspections for remote field locations are now being offered by Pipe Inspectors, a newly created division of Plastic Applicators, Inc. The mobile units were developed to complement regular in-plant services including hydrostatic testing, hardness testing, cleaning, and doping pipe.

Fred Wilbur becomes manager

F. M. Wilbur

. . . of advertising and market development for Oil Well Supply Division of United States Steel Corp., announces M. F. Hazel, vice president in charge of sales. Wilbur succeeds Max E. Shippee who retired. At the same time John D. Winkworth was promoted to advertising assistant.

Wilbur joined Oilwell at Odessa, Tex., in 1948. The next year he was transferred to the division headquarters office at Dallas as assistant to the general sales staff manager. A year later he became manager of sales personnel training and, in 1954, was named executive assistant of personnel development and training. Since 1955 Wilbur has served as assistant to the director of employe relations.

Winkworth was employed by the division in 1947 at Oil City, Pa. In 1948 he moved to New York City as a service engineer and, in 1953, was transferred to Dallas as a training technician.

3 managerial assignments made

. . . by Geo. W. (Jack) Walton, president of Ideco Division of Dresser Industries, Inc., Dallas.

J. C. Young has been transferred from London, England, to Rome, Italy, as manager of Ideco Division, Dresser Italy. He also will continue his duties as manager, Ideco Division of Dresser A.G. Prior to his transfer to England in 1959, Young was central service manager of Ideco with headquarters in Dallas.

W. L. (Bill) Farrow has been appointed manager of Ideco Division, Dresser (Great Britain), Ltd., with offices in London. He was formerly with Dresser International in Rio de Janeiro, Brazil. Prior to his association with Dresser and Ideco, Farrow was managing director of Edeco (Trinidad), Ltd., a subsidiary of English Drilling & Equipment Co.

Shannon L. Matheny, Jr. has been promoted to New York export manager. He joined Ideco in 1957 in the California oil-field sales, Long Beach office. Matheny was formerly with Standard Vacuum in Indonesia and with Continental Oil Co. in California.

Dewitt T. Dees rejoins

. . . Baash-Ross Division of Joy Mfg. Co. as district sales representative in Shreveport, according to R. A. Forsman, director of sales and service. Dees had been with Baash-Ross for 4 years when he left last year.

T. M. McLoughlin joins UOP

. . . as product sales representative, reports M. R. Schrein, senior vice president. McLoughlin will service the eastern seaboard states while operating out of Philadelphia. Before joining Universal Oil Products Co., he was with Wabash Chemical Co.

William Haley is named manager

W. F. Haley

. . . of the newly established southwest district office of Union Switch & Signal Division of Westinghouse Air Brake Co., Houston. The announcement was made by Theodore C. Schroeder, product manager, systems. The Houston office will facilitate marketing of pipeline systems in the southwestern area.

Haley started with Union Switch & Signal in 1952. For the past year he has been area representative for systems marketing in the southwestern area. Haley will be assisted by William L. Hendricksen, who recently joined the sales department as a sales engineer.

Beckman Instruments appoints

. . . Robert L. Sinek, Herman L. Steudel, and Frederick M. Teetzel as sales engineers in the midwestern region of the company's Scientific & Process Instruments Division, reports Robert A. Piper, midwestern regional manager.

Sinek, who will assume duties of process sales engineer in the firm's Cleveland office, replaces Richard E. Schmidt, who has moved to Houston to take over Beckman accounts in that area. Sinek, who joined Beckman in March of this year, earlier was with Sohio as a senior process engineer.

Steudel will assume duties of proc-

NEW PIPE-COATING PLANT of Tube-Kote, Inc., located at Edmonton, Alta., is built on an 8½-acre plot and cost $300,000. With a coating capacity of 8,000 ft. of pipe per day, the facility will employ about 35 men. Management for sales and operation of the plant is the responsibility of Joe H. Williams. Roger L. Hutchinson is sales representative and Mack E. Dominy will supervise plant production.

FOUR WAYS TO INSURE GOOD COATING PROTECTION

Continuity is all important in a protective coating. Whether it's a 90 mil coating on a pipeline or a 3 mil coating on a chemical tank, a tiny pinhole can lead to the destruction of the coating. Use of a Tinker and Rasor Holiday Detector will quickly locate pinholes as well as weak spots caused by air bubbles, coke, rust or scale. Minutes spent inspecting with a Tinker and Rasor Holiday Detector while the job is open can save days of down time later on.

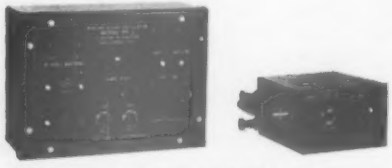
Pipeline Detectors

E-P For damp or dry surface, high electrical resistance coatings. Output adjustable from 8000 to 20,000 pulsating voltage. Electrodes available: half circle, spring for pipe to 6", full circle to 30" silicone brush for flat surfaces.

E-4 This lower cost type of detector is specifically designed for smaller diameter pipe and flat surfaces with dry surface, high electrical resistance coatings. Output adjustable from 8000 to 20,000 D.C. voltage.

Thin Film Detector

M-1 For painted or sprayed thin film coatings. Maximum applied voltage 67½ V., non-destructive to coatings. Belt mounted, 4 lbs. total wt.



Underground Pipeline Detector

P-D For detecting holidays, electrical contacts or locating the pipeline itself, **without uncovering the pipeline.** Completely transistorized—long life and light weight.

Engineering Note:

Every protective coating specification should include TR Holiday Detector inspection. Write for specification guide.

DISTRIBUTORS:

Falcon Line Products Corp., Kearny, New Jersey
Crutcher-Rolfs-Cummings, Inc., Houston, Texas
Remco Manufacturing Co. Inc., Tulsa, Oklahoma
Bob Herrick, New Cumberland, Pennsylvania
Canadian Equipment Sales & Service Co. Ltd., Edmonton, Alberta, Canada

Export Agent: Frazar & Hansen Ltd., San Francisco, Calif.

Write today for technical data and bulletin.

Quality Control for Coating Application

TR TINKER & RASOR

417 Agostino Road, P.O. Box 281 • San Gabriel, California

ess sales engineer in Chicago, replacing Herbert Feitler, who has been promoted to product line manager in Beckman's Fullerton, Calif. office. Before joining Beckman in July, Steudel had been with the Controls Division of Black, Sivalls & Bryson, where he spent 4 years as a sales engineer. Earlier he was with Reade Mfg. Co.

Teetzel, who joined Beckman in June, has been assigned as a scientific sales engineer in the Cleveland office. He previously was with Monsanto Chemical Co. for 4 years and with National Lead Co. for 8 years.

Grove Valve & Regulator makes

C. E. Doty

. . . three changes in its sales organization. George E. Doty, former vice president of sales, has been elevated to vice president and general sales manager and will be in charge of all sales activities. He will locate at Grove's home offices in Oakland, Calif.

B. J. Hancock, former eastern regional sales manager, has been named vice president of sales and will be responsible for all field sales. He will be stationed at Houston. E. C. Bird

B. J. Hancock

E. C. Bird

has been appointed a district sales manager in Houston and will handle sales of production valves in that region. He previously was a division manager for Gulf Coast Machine & Supply Co., of Houston.

Oakite promotes Basch, Baltzell

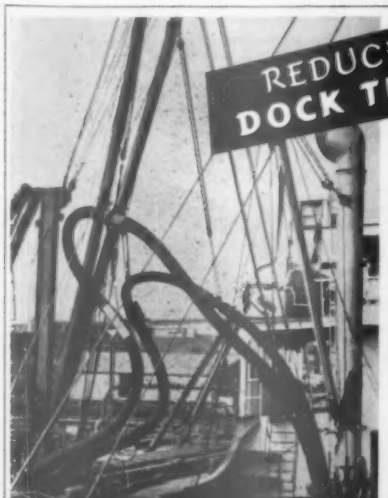
. . . to positions of second vice president and vice president, respectively.

J. Justin Basch joined Oakite Products, Inc., in 1925 as representative in Pittsburgh. He became Philadelphia division manager in 1930, and has been vice president in charge of marketing since 1958. He will continue to be responsible for the firm's marketing and research and product-development programs.

William A. Baltzell has been with Oakite since 1941, first as sales representative in Dallas, then as manager

SPECIALIZED
MANAGEMENT
works for
Oil Properties
in Trust

Personal Trust Department
MERCANTILE
NATIONAL BANK
DALLAS, TEXAS



REDUCE DOCK TIME

WITH PARANITE LOADING HOSE

- Hycar Tube—High-Octane Resistant
- Uniform Bore Assures Rapid Flow—Suction and Discharge
- Oil, Abrasion and Weather Resisting Neoprene Cover
- Type "C" Built-in, Leakproof Fittings
- 7 Types for Pressures to 200 psi.

Paranite Loading Hose for years has been recognized for long service.

Furnished in 7 types, smooth-bore, rough bore, for sea and dock ship loading and for barge service.

Ask about R/M Rotary Hose, Mud Pump Intake Hose, Vibration Hose, and Non-Bursting Steam Hose.

RM 1047

RAYBESTOS-MANHATTAN, INC.
MANHATTAN RUBBER DIVISION, PASSAIC, NEW JERSEY
ENGINEERED RUBBER PRODUCTS.. MORE USE PER DOLLAR

TOLED-O-MATIC*

cleans and deburrs all tubing and fitting sizes thru 4"...

Ready For Work
$128.50
*MAKES EVERY WORKMAN A CRAFTSMAN

IT's NEW...TOLED-O-MATIC No. 1
For Copper Fittings and Tubing

- ELIMINATES COSTLY HANDWORK
- ELIMINATES LEAKS
- INSURES LIFETIME JOINTS
- TRUE PORTABILITY
- LOWEST PRICED, PRECISION BUILT

Cleaning and deburring the new Toled-o-matic way eliminates costly line leaks and profit-robbing hand "reworking" operations. Tubing and fitting surfaces take on mirror-like brightness insuring perfectly tight connections. Put the Toled-o-matic No. 1 to work Now, in your shop or on the job . . . see the difference!

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PIPE THREADERS • WRENCHES • MACHINES • TUBING TOOLS

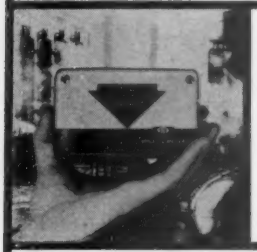
THE TOLEDO PIPE THREADING MACHINE CO...TOLEDO 2, OHIO

Only $285 per pound (prox!) —and They're real space savers, too.

The Series BH100

MILLI-V-METER®

The Instrument with the TAPE-SLIDEWIRE



for PETROLEUM, CHEMICAL, STEEL, ALUMINUM and other processing plants...

to accurately indicate

TEMPERATURE, FREQUENCY, FLOW, LEVEL, PRESSURE, R.P.M., WEIGHT, etc.

Every function of the producing plant may be measured *and controlled* with high accuracy. Ideally small and designed for uniform panel installation, the MILLI-V-METER is completely self-contained... including power supply, servo unit, slidewire and amplifier. Every measurement exhibited on the counter is a precisely (electronically) calibrated value.

1/10 the size

10 times the accuracy

of standard instruments

QUALITIES

1) Accuracy 1 part in 1000. Laboratory precision for industry or the military.
2) Compatibility with any transducer—AC or DC.
3) For strain gage, linear differential transformer, thermocouple, thermistor, resistance thermometer, pulse or variable frequency circuits or systems.
4) Operates directly from 60- or 400-cycle power as specified.

SPECIAL FEATURES

For Recording... a re-transmitting slidewire may be provided within the case.

For Controlling... switch contacts may be provided to operate control units, remote indicators, or printers.

For Computers or Telemetering... counters with decimal outputs may be added

Produced by the makers of JETCAL® *jet engine Analyzer ...in worldwide military and airline use!*

Full information is available for the asking!

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HOWELL INSTRUMENTS, INC.

FORMERLY B&H INSTRUMENT CO., INC.

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of the company's southern division. In 1958 he was appointed industrial sales manager, the position he will continue to hold.

George S. Trees elected veep

...of Chicago Bridge & Iron Co., steel-plate fabricating and construction firm. He was named a regional sales manager by the company earlier this year. Trees joined CB&I in 1939 and has served in various engineering and administrative positions. He was elected a director 6 years ago.

Reed Roller Bit Co. purchases

... all outstanding stock in Electrodynamic Instrument Corp. for an undisclosed price. Electrodynamic was founded by Joseph J. Houghton and Paul E. Madeley about 5 years ago for the purpose of designing and manufacturing electronic and electromechanical instruments. Today EIC is engaged in a wide variety of instrumentation and electronic-components work.

Robert Meiklejohn is reassigned

... to BJ Service, Inc., as manager of the Wire Line Division. For the past 3 years he has been on a special assignment with the Borg-Warner development team that introduced nuclear magnetism logging to the oil fields.

Meiklejohn started with BJ in 1948 doing experimental and development work on the jet-perforating process. Since that time he has been associated with the development of other special logging and well-perforating techniques. He will maintain offices in Long Beach, Calif.

Merla Tool Corp. appoints

... Spalco Engineering Services, Ltd., as Canadian distributor. Spalco, headed by J. G. Spalding, has offices in Calgary and Edmonton.

Tex-Tube names Norton Moore

... as project engineer, in which post he will supervise the introduction of new projects and services produced by the firm's research and development group. His first assignment will be supervising early field installations of

. . . at products pipeline terminal of nationally known oil company

The LimiTorque Valve Controls shown above are of the *Integral Control Type* (pioneered by LimiTorque). . . . *These self-contained "packaged units" offer integrally mounted NEMA rated reversing controllers, push-button and indicating light elements . . . The push-button elements, selector switches, etc. are all mounted inside the hinged cover for quick, easy accessibility.

LimiTorque "Integral Control" Valve Operators can save up to 50% over separate component equipment and installation costs—and, they are simple, foolproof and absolutely dependable. Send for LimiTorque Bulletin 10-A58, which completely describes and illustrates these new and exclusive Units.

There is no guess work or labor connected with LimiTorque Valve Controls—one man can open and close any type of valve, quickly and dependably in remote or hazardous locations.

LimiTorque may be actuated by any reliable power source, such as Electricity, Oil, Gas, Water or Air.

LimiTorque Operators can be field-mounted on existing valves . . . contact your valve manufacturer or nearest LimiTorque sales-engineering office.

THERE IS NO SUBSTITUTE FOR —

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PHILADELPHIA GEAR CORPORATION
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Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID AGITATORS • FLEXIBLE COUPLINGS
Limitorque Corporation • King of Prussia, Penna.

total project management for the pipeline industry

Feasibility studies
Project engineering
Financing
Construction

SOMERVILLE CONSTRUCTION COMPANY
ADA, MICHIGAN

Tex - Tube's new epoxy - joined line pipe.

Moore joined the Houston company as an inside salesman in 1955 after several years with Corbett Corp. and Halliburton Co. He was promoted to purchasing agent in 1957 and held this position until now.

Western Co. promotes, shifts

. . . five management employes, announces Walter Beadle, executive vice president of the Fort Worth oil-well-servicing firm.

Harold E. Parsons, former Rocky

H. E. Parsons

Don Walters

Mountain division manager, has been named vice president in charge of the South America division, and will establish offices in Buenos Aires, Argentina. Donald Walters, Parsons' replacement at Farmington, N. M., moves up from assistant division manager of the Midland, Tex., division.

B. J. Bucy has become technical assistant to the executive vice president in Fort Worth. He was division engineer at Oklahoma City. Jean Barrett, former division sales manager at Oklahoma City, will assume duties as city sales representative in Dallas. Laddie Harp, acting division sales manager at Midland, will become division sales manager at Oklahoma City.

Tony Vanderhoef is named

. . . service representative in the Rocky Mountain district for Technical Oil Tool Corp., according to John Davis, general sales manager. Vanderhoef will be located at Casper, Wyo., and will operate under the supervision of District Manager Eldon Snyder.

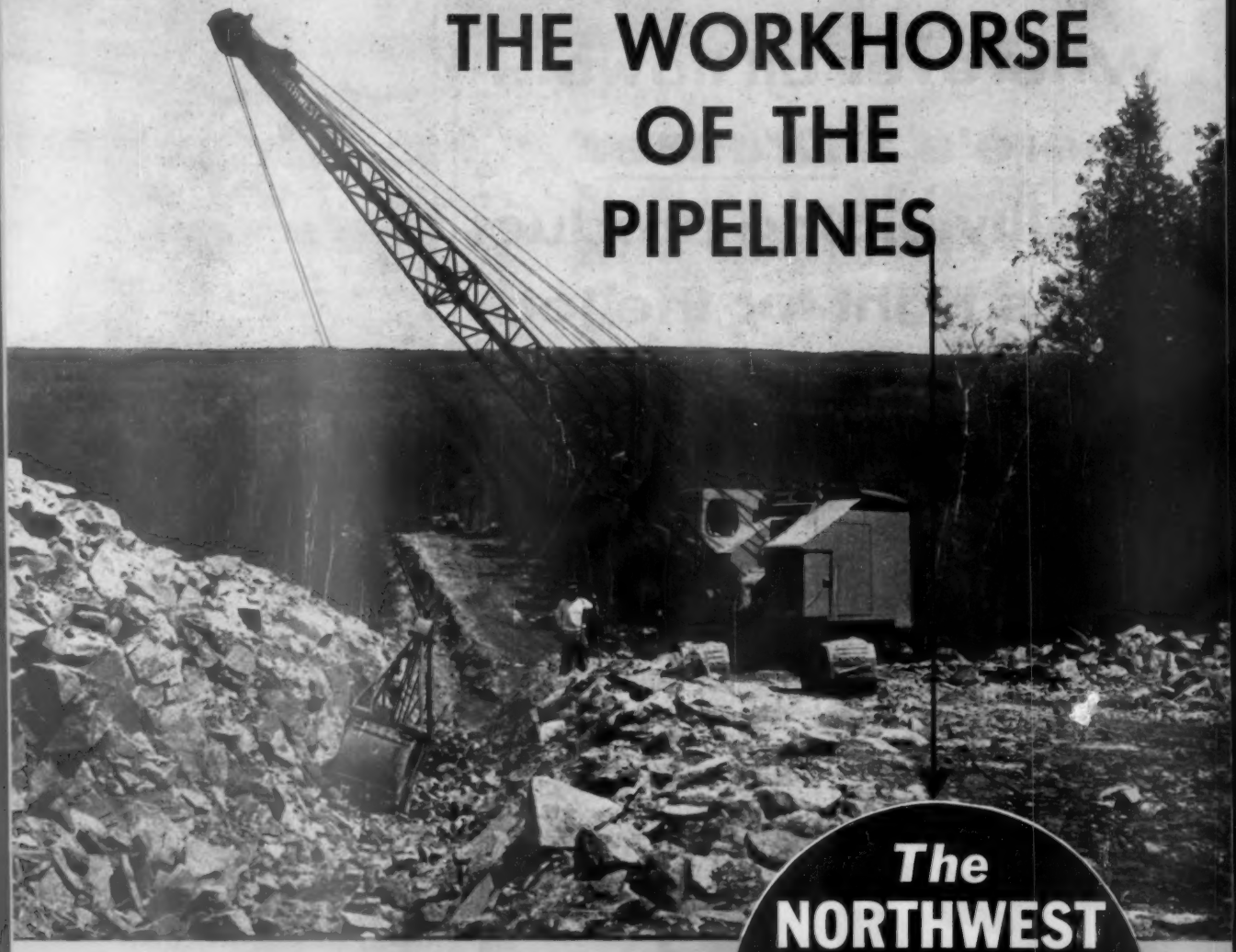
Minneapolis-Honeywell appoints

. . . new general managers for two of its Industrial Products Group divisions.

Kenneth Brierley assumes responsibility for activities of the Fall River, Mass. division, a producer of electronic process instrumentation. John H. Hagen takes over Brierley's former post as head of the Rubicon Division, which manufactures test and calibration instruments.

The personnel changes send George W. Hoffmeister, general superintendent of the Fall River unit since its inception in 1957, to the Datamatic

THE WORKHORSE OF THE PIPELINES



The NORTHWEST 25-D AND 25-D 18-TON LIFTING CRANE

MANY pipeline contractors have spoken with amazement of the versatility and dependability of the 25-D. Here is a workhorse you can count on. Beginning with controls, the Feather-Touch Clutch Control gives you the accuracy and feel of the load necessary for almost micro-matic placement in spotting a load, setting pipe or pipe weights. The velvet action of the larger Uniform Pressure Swing Clutches eliminates the jerks and grabs often characteristics of band-type design. Northwest Uniform Pressure Swing Clutches will run hour after hour and give trouble-free service without blowers. You have boom hoist equipment unequaled for ruggedness on any other machine.

The Northwest Independent High-Speed Worm Boom Hoist operates through Uniform Pressure Clutches under power both up and down. A spring loaded auxiliary brake automatically releases when raising or lowering the boom and the boom can be locked in a fixed position when desired.

Positive Power Load Lowering provides positive operation with a single lever control in conjunction with the right-hand drum clutch. It can be engaged or disengaged at will, either free or under load. There is no backlash and a Uniform Pressure Clutch assures smooth action.

When a third hoist line is required a 3rd drum becomes part of the equipment and, with a dragline Fair-Lead in place, you have the ability to move from pile driving equipment with live leads to dragline operation.

Every feature you need is available for any crane job and the standard 25-D is supplemented by a 25-D, 18-ton Lifting Crane.

Get the full details on this able workhorse. It has been proved on miles of pipeline work.

NORTHWEST ENGINEERING COMPANY
1513 Field Bldg., 135 South LaSalle Street, Chicago 3, Illinois

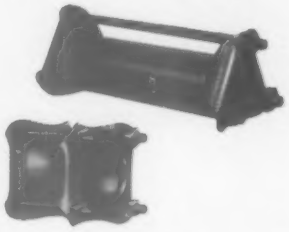
C-25-45-LC

Wherever oil flows... There's a Dresser® quality piping product that's right for the job

FOR GROOVED END PIPE

Dresser "KUPL + LOK" (TM) Couplings and Fittings, 500# & 1000# types.

FOR PLAIN-END PIPE



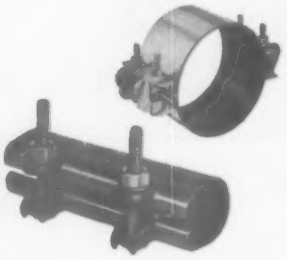
Style 40 Long Sleeves for spanning gaps between pipe ends.

Style 38 Couplings for regular applications.

FOR SMALL DIAMETER PIPE

Dresser Compression Couplings and Fittings . . . Sizes thru 2".

FOR PIPE REPAIRS



"360" Clamp for Asbestos-Cement Pipe "Handiband" Clamp for Steel Pipe

All the pipe joints you need for fast installation on tank batteries, gathering lines, mud pumps, salt-water disposal lines . . . now in stock at your supply store.

All the easy-to-install, permanent repair products that enable you to stop leaks fast . . . now in stock at your supply store.

Insist on Dresser quality when you buy pipe couplings, fittings and repair products. Every Dresser product is clearly marked . . . your guarantee of highest quality.

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DRESSER
MANUFACTURING DIVISION

ONE OF THE DRESSER INDUSTRIES

Division in Boston in a staff assignment.

Brierley joined Honeywell's Brown Instruments Division in 1946 and has served in a number of executive and managerial capacities. Hagen has been with the company since 1933, first in Minneapolis and, since 1940, in Philadelphia. He formerly served as industrial relations director for Brown Instruments.

Hill Hubbell Co. appoints

. . . Norman A. Morella as project engineer at the company's new research center in Elyria, Ohio. Early assignments will include the development of new methods and processes for coating pipe. Morella was formerly with Perfection Industries and Baker-Rauling Co.

R. W. Reekstin is appointed

R. W. Reekstin

. . . manager of hydraulic sales for Axelson Division of U. S. Industries, Inc., announces L. G. Evans, vice president in charge of sales. In his new capacity, Reekstin will be responsible for the entire hydraulic sales and service organization, including offices and warehouses in Long Beach, Calif., and Odessa, Tex.

Prior to his appointment he was technical sales engineer, chief engineer, and engineering manager of Axelson's Petroleum Technical Service Group. He has been with the company 13 years.

L. T. (Lex) Shackelford joins

. . . the city sales staff of Atlas Pipe, Inc., of Houston, according to W. T. Pearson, sales manager. Shackelford has been in oil-field-equipment selling since 1946. For the past 8 years he has been selling oil-field-tubular goods in Texas, Oklahoma, and Louisiana.

VENTS will be installed at grade crossings by Mid-America Pipeline. The vents, with corresponding markers, are manufactured by Fleet-Line Co., of Shreveport.

Jimmie Gray®

500 TON

... now with

POLARIZED

ADDITIVE!

Greater "Clinging" Power for Increased Thread Protection!

Used on more wells throughout world-wide drilling industry!

SOLD ONLY THROUGH SUPPLY STORES

MONEY BACK GUARANTEE

USE JIMMY GRAY DOPE BRUSHES

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SPEED UP THE FLOW OF PIPELINE FLOW CHARTS WITH CHART-PAK TAPES

Chart-Pak tapes save you hours of drawing drudgery. You don't ink-in or paint lines, bars, shapes and symbols. You tape them on . . . fast . . . with Chart-Pak pressure-sensitive tapes and sheets!

Corrections are easy with Chart-Pak, too. There's no such thing as a mistake you can't fix . . . a change you can't make. If a line or symbol is in the wrong place, you can lift it up and replace where you want it.

DON'T DRAW IT...TAPE IT WITH CHART-PAK

Write for free folder — "Visualization Made Easier."

CHART-PAK, INC., 191 River Road, Leeds, Mass.

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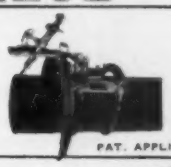
H&M PRODUCTS FOR PROFITABLE PIPE CUTTING AND BEVELING

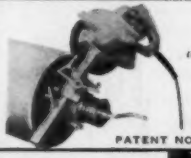
STD. MACHINES



PAT. APPLIED FOR

FAST, accurate cutting and beveling of all sizes of pipe from 1½" - 36". Simple operation . . . operator can master machine in a matter of minutes.

"BEVEL-LAND" GRINDER



PATENT NO. 2,869,292

No more time consuming handwork. "BEVEL-LAND" smooths pipe cuts and accurately places the lands on bevels in a matter of seconds.

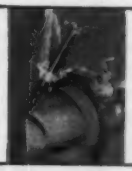
OUT-OF-ROUND

Insures even, accurate cuts of irregular pipe. Roller rides pipe surface . . . makes cutting easy, simple. Fits all H&M Machines.

PATENT NO. 2,843,373

SHAPE CUTTER

Accurately cuts saddles, tees, els and other irregular shapes. Lightweight, extremely portable . . . fits all H&M Machines.



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WRITE FOR CATALOG SHEETS AND PRICE LISTS ON THE COMPLETE H&M LINE.

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TULSA, OKLAHOMA

MOST RESPECTED PACKER

It's known the world over for sheer downright dependability

BAKER RETAINER
PRODUCTION PACKER
PRODUCT 415-D

THE DOUBTS that harass well operators got a real body blow when the now-celebrated Baker Retainer Production Packer was developed some years ago.

This is probably the most predictable (and certainly the most respected) packer ever to go into an oil well. It commands the respect and confidence of operators the world over.

WHAT'S THE SECRET of building a packer so tough and reliable you know it will keep you honest when you recommend it?

For one thing, it takes time—years of performance studies. We've sweated out failures and assessed our successes—sifted out weak points and strengthened the strong points.

This great packer is at work right now in tens of thousands of wells—the average wells, the corrosive wells, the deep, hot, high pressure wells.

THAT'S A TOUGH proving ground—one that has helped us soak up a vast knowledge of what happens to slips, packing elements, and the like, when a packer is downhole. We've got the facts.

Baker made the first retainer packer—for many years the *only* retainer-type packer. The result is a wealth of packer experience that's hard to equal.

This remarkable packer shows it. Over the years we've refined it into a tool that has unyielding stamina. That's why we can call it the most predictable packer of them all.

This great packer has many applications—it's as versatile as it is dependable. It's a single-string production packer that comes in many sizes and bores. Moreover, it is surrounded by a family of accessories that transform it into a dual or triple packer—or into a temporary or permanent bridge plug or squeeze tool. Its formidable pressure-holding capacity makes it in many ways one of the finest of all squeeze packers.

It is set on a wire line—or on tubing or drill pipe. Baker's fast new milling tool mills one out in two to four hours—a fourth the time it once took.

For the latest practical knowledge of how to use Baker Retainer Production Packers, call your Baker Representative.

BAKER

RETAINER PRODUCTION PACKER

BAKER OIL TOOLS, INC. HOUSTON / LOS ANGELES / NEW YORK

▶ ▶ ▶ **Among the Drilling Contractors**

All wells in Colorado field are air-drilled

PRODUCTION at Sage Creek anticline was discovered in the fall of last year at English Oil Co. 1-36 State, SE NE 36-5n-88w, Routt County, Colorado. Finding oil at this Northwest Colorado feature prompted the Salt Lake City operator to deviate from regular drilling techniques.

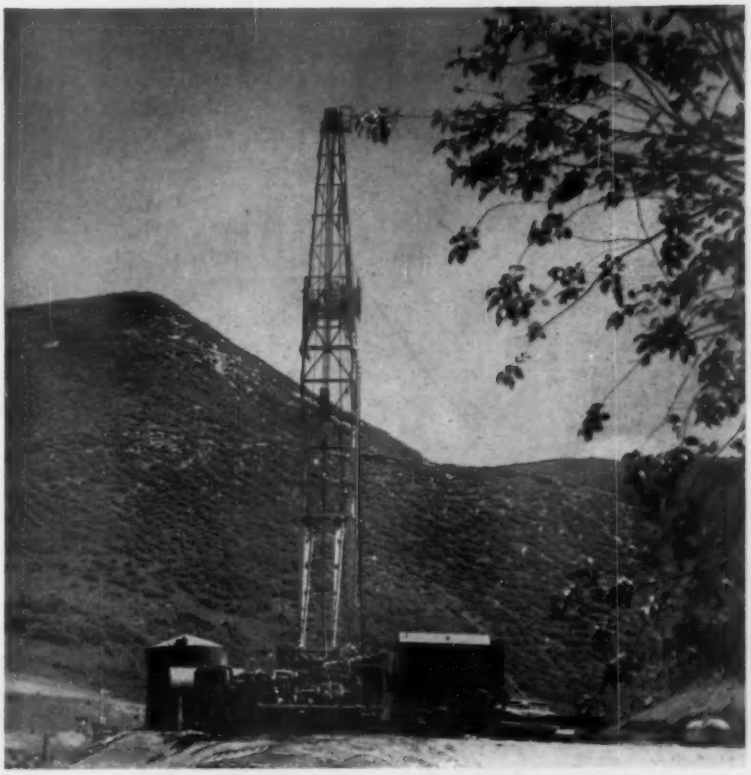
All wells have been drilled with air as the drilling medium. Air was used to keep the holes in gage, without cave intervals, and lost-circulation problems were avoided. The wells were completed in open hole so that cement would not contaminate the fractures of the pay formation. With the exception of the discovery well, the holes were completed with 2⅜ or 2⅞-in. tubing run on an open-hole packer. The use of the packer was intended to prevent uphole sidewall sloughing down to pay. Slim-hole completion preserves the full diameter of the bore hole for future deepening to a lower zone when the initial pay is depleted.

The pay was from a fractured shale, the Niobrara shale member of the Mancos formation. The Upper Cretaceous-Niobrara is approximately 1,000 ft. thick with fractures occurring anywhere within its upper and lower limits. Commercial accumulations of 40°-gravity sweet crude were found in this reservoir. Initial production of the field opener was 90 bbl. per day with no water, though the well was 1,100 ft. below the structural crest of the anticline. Today, after nearly a year of production, the well is making 70 bbl. daily.

Two offsets have been completed on 40-acre spacing from the discovery for small producers. These are the south and east stepouts. The east well, English 12-31 Hite, SW NW 31-5n-87w, was recompleted by deepening the well to force the test off the crest of the anticline and the well is being put on pump.

To the north, another well has been drilled, English 34-25 Baierl, SW SE 25-5n-88w, and is now testing. The holes vary in depth from 3,136 to 4,871 ft. One of the main problems is anticipating the fractured depth of the pay on the steeply dipping (30° to 60°) flanks of the anticline.

English claims a very satisfactory economic air-rotary drilling program that insures stable holes with no fracture nor formation damage. Their completion program is aimed at reducing the tangible investment to a minimum so as rapid as possible payout results.



THIS PICTURESQUE LOCALE is the scene of development for English Oil Co., Salt Lake City, who is expanding production at Sage Creek anticline in Northwest Colorado. Willard Pease Drilling Co. of Grand Junction, Colo., operates this portable Failing Model 90 Stratmaster rig.

The contractor, Willard Pease Drilling Co. of Grand Junction, Colo., has used this rig for several years. The drill is a Failing Model 90 Stratmaster designed primarily for slim-hole exploration or production tests. Because of its portability, this drill is able to traverse the rough and often nearly inaccessible mountain locations. Standard equipment on this drill includes a cantilever 83-ft. mast that will rack 6,500 ft. of 2⅞-in. or 5,000 ft. of 3½-in. drill pipe, a 100,000-lb. load hook, two Gardner-Denver 180-hp. medium high-speed type engines, Allison TG-607 Torqmatic transmission, a 16-in. opening rotary table, and consoled air controls. The trailer-mounted rig when traveling is 8 ft. wide, 50 ft. long, and weighs 50,000 lb.

New drilling map available

A SPECIAL MAP of interest to operators and drilling contractors is now available by a Denver firm. Data obtained from wells drilled in the Rocky Mountain area have been studied and the information pertaining to air-gas drilling operations is plotted on an index map.

The information includes the location of the well, the techniques used, and lists the formations in which air-gas drilling has been successful. Some of the notations include remarks which provide a clue as to why the air-gas medium was used. These are: lost circulation, penetration improvement, formation evaluation, completion technique, and air application attempted. By looking at a graphic statigraphic sequence of formations, it is readily apparent which of these have been successfully drilled with a gas medium. The names and ages of the formations are shown.

The index map is 35 by 45 in. and its scale is 1 in. to 24 miles. The map and statistical index is offered by Drilling Analysis Service Co., 220 C. A. Johnson Building, Denver. Prices are available upon request.

DOWELL CUSTOMER GETS

"NEW" WELL FOR PRICE OF FRAC JOB

Engineered fracturing—as practiced by Dowell—can do many things for producers. Treatments can increase production, reduce workover and production costs, improve gas/oil or water/oil ratios, and increase recoverable reserves. Fracturing has even saved valuable wells from abandonment.

A Texas Panhandle producer feels like he got a "new" well for the price of a frac job . . . here's how it happened:

Production had declined to 11 bopd—pumping—from an old well completed into the Cleveland sand. Completion was through perforations from 6420 to 6458 feet. Workover was considered because new offset wells tested 400 bopd on completion.

Dowell engineered a fracturing treatment with the "Frac Guide"*. Waterfrac was selected for efficiency and low cost. 40,000 gallons gelled water and 105,000 pounds sand were used. 70 gallons of Freflo* were used to prevent emulsions, and 100 ball sealers were used to divert part of the treatment into less permeable zones. Injection rate was 65 bpm at 900 to 1400 psi down seven-inch casing.

Following treatment, *production stabilized at 105 bopd flowing*. Payout time for fracture treatment was four months.

DOWELL FRACTURING AND ABRASIJET HELP GET GOOD PRODUCTION FROM "PROBLEM" FIELD

Wells in the Langlie Mattix field of Lea County, New Mexico, are hard to produce. The oil pay of the Seven Rivers formation is tightly sandwiched between water below and gas above. It will not produce satisfactorily without stimulation—yet fracturing usually results in water or gas rather than oil.

Dowell engineers suggested a two-stage treatment that is working extremely well. First, Abrasijet* is used. The jetting tool is set in the middle of the oil zone at about 3585 feet, and the walls of the open hole are jetted with oil and sand. This produces considerable enlargement of the well bore.

Then wells are fractured, using 10,000 gallons lease crude and 10,000 pounds sand. This relatively small treatment is designed to provide the needed stimulation without breaking through to either gas or water.

Success has been outstanding. *The first fifteen wells treated are all producing their allowables; only two are producing appreciable water and none have broken through to gas.*

OPERATOR USES DOWELL FRACTURING TO STRETCH OUT DECLINE CURVE

Wells completed in the 'D' sand of the Southwestern Wayne pool in McClain County, Oklahoma, had not responded well to fracturing. Usual treatments had been 10,000 to 20,000 gallons of refined oil carrying one pound of sand per gallon. Initial production would be satisfactory but production would decline rapidly—frequently approaching pre-treatment levels in less than a month.

Dowell engineered a treatment with the "Frac Guide". Petrojel* was recommended for a well completed through perforations from 6977 to 6994 and from 7062 to 7076 feet. 20,000 gallons gelled crude with F.L.A.* (Fluid Loss Additive) and 46,000 pounds sand were used. 25 ball sealers were injected at mid-treatment. Injection rate was 21 bpm. *Before treatment, production was 10 bopd. Three months later, production had STABILIZED at 30 bopd.*

GOOD GAS/OIL RATIO RESULTS WHEN KANSAS OPERATOR USES DOWELL FRACTURING AND ABRASIJET

Wells completed into the Mississippi Chat of the Spivey-Grabs pool in Harper County, Kansas, have a GOR limit of 3000/1. An operator wanted to fracture to improve production—yet not break through to gas. Abrasijet was used to perforate casing at 4464 feet. Then, following treatment with 500 gallons Mud Acid, well swabbed 12 barrels of oil in seven hours.

After fracturing with water and 3500 pounds sand the well *flowed* 10 boph on a ¼"-choke. *Gas/oil ratio was only 1323/1—exceptionally good for the field.*

Your Dowell engineer can help you select a treatment to solve your well problem. Call him for further information or service. Dowell services and products are offered from more than 150 offices and stations in the United States, Canada, Argentina, and Venezuela. Dowell, Tulsa 1, Oklahoma.

*Dowell Trademark

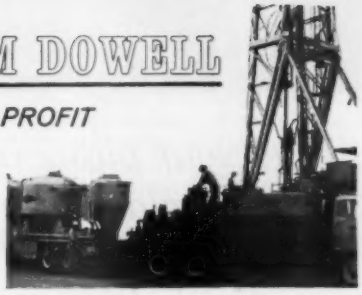
Services for the oil industry

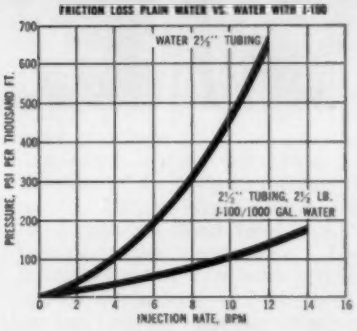
DOWELL

DIVISION OF THE DOW CHEMICAL COMPANY

NEW IDEAS FROM DOWELL

TO HELP YOU MAKE MORE PROFIT





ROCKSHOCK*

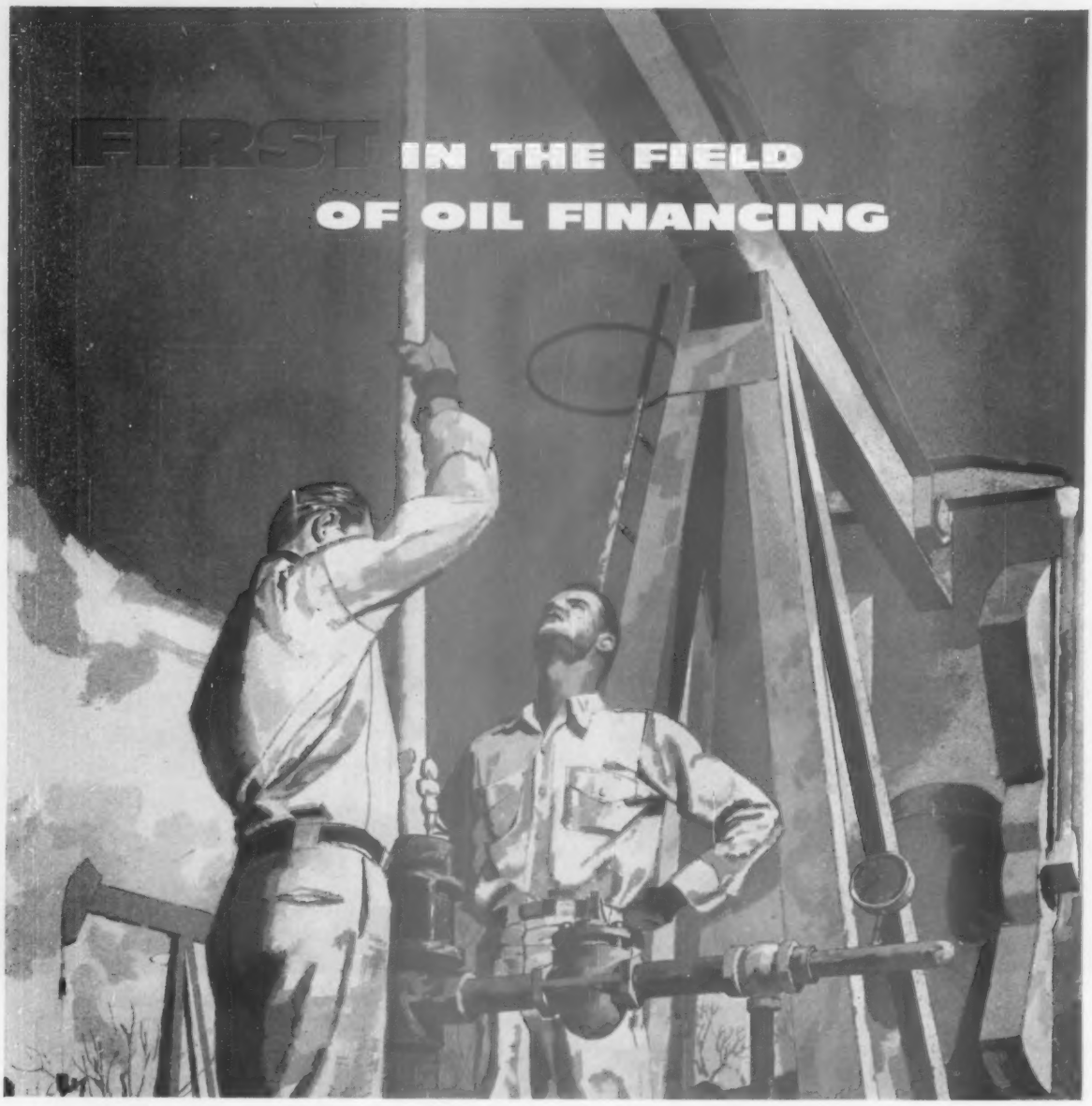
This new Dowell service employs glass *implosion* capsules to clean formations or reduce breakdown pressures ahead of fracturing or acidizing treatments. Hydrostatic pressure is used to break the capsules. This action releases powerful pressure waves—to remove scale and other deposits, break emulsion blocks, and to initiate fractures.

FLAC*

This new fluid loss control additive for cement is a major breakthrough in both squeeze and casing cementing techniques. It cuts fluid loss to almost any desired extent without affecting other characteristics excessively. Supplies are limited at present, but operators are invited to familiarize themselves with FLAC so it may be used when it becomes more available.

SLICK WATER (J-100)

This is Dowell's new, improved thickening and friction reducing agent for fresh water. It effectively improves the sand-suspending qualities of water. More important, however, is its ability to reduce friction losses and pump requirements by more than one-half as shown on the graph. The result can be better fracturing at lower cost.



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Wyoming hit snaps Wind River lull

WYOMING'S Wind River basin has its biggest oil strike since Grieve unit was opened about 5 years ago. The newest addition to one of the Rockies' most formidable wildcat barriers is Wallace Creek.

National Cooperative Refinery Association 1 Wallace Creek unit, SE NW 22-34n-87w, Natrona County, flowed 1,416 bbl. of oil per day on drill-stem test of the Muddy zone of Thermopolis shale (Upper Cretaceous). Pay was hit at 10,333-74 ft.

Oil was light green. Sample top of the Muddy was 10,303 ft. Final 30-minute shut-in pressure was 4,606 psi The operator is now drilling below 10,438 ft. with projected depth in the Morrison Jurassic.

THERE IS MAJOR OIL-DISCOVERY NEWS in a far-removed wildcat area of Natrona County in Wyoming's lagging Wind River basin. The Wallace Creek well breaks the lull of big oil finds since Grieve.

A southern switch. Exploratory news from the southeastern part of Wyoming's third largest basin is rare. Not since Muddy production was opened at prolific Grieve unit has there been much to talk about in this corner of Wind River. Nearest production is 8½ miles north at Cooper Reservoir, one of last year's gas stories in the Rockies. Raderville field lies 10 miles northwest, Grieve 17 miles southeast.

There were two earlier deep tests drilled on the Wallace Creek unit. Bay Petroleum Co. found a little gas at 1 Unit on test at 10,353-10,587 ft. in 1950. The California Co. 1 Twidale had spotty oil showings in the Muddy at 9,852-9,948 ft. later. Other drilling in this section of Wind River has been way up the hole. An interesting trend, northwest-southeast, appears on the map—a trend that begins at Raderville, through Wallace Creek, Grieve, Fish Creek, Spindletop, and Bolton Creek (the last three off the map to the southeast). This trend follows closely the southeastern liimts of the basin, unlike most Wind River trends that do not parallel basin margins.

From northern areas. Most Wind River exploratory noise has been on the northern flanks for 3 years. A far-removed gas discovery at Lost Cabin in Lance (uppermost Cretaceous) rocks cracked a corner of the Rockies that had been almost forgotten. Then came the deepest producing well in the Mountain States at Badwater in Cretaceous rocks at 16,472 ft. Following these events a lively drilling program got under way in the Lost Cabin and Lysite areas on this mixed-up north flank of Wind River. Wind River Tertiary oil was found at West Lysite. That set off a brisk search in rocks that hadn't produced oil before. Important discoveries in remote areas last year were made at Waltman unit, Cooper Reservoir, and North Lysite. Waltman was the first Lance oil producer in Wyoming. Tertiary gas was tapped at Cooper Reservoir and North Lysite to round out a busy year for the northside.

These discoveries on the northern side of the basin during the past 2 years moved wildcatters into one of the most highly disturbed sections of the Rockies. Wind River basin has had good production for many years, but the last strikes of real importance before current campaigns were at Grieve in the southeast and Rolff Lake on the northwest.

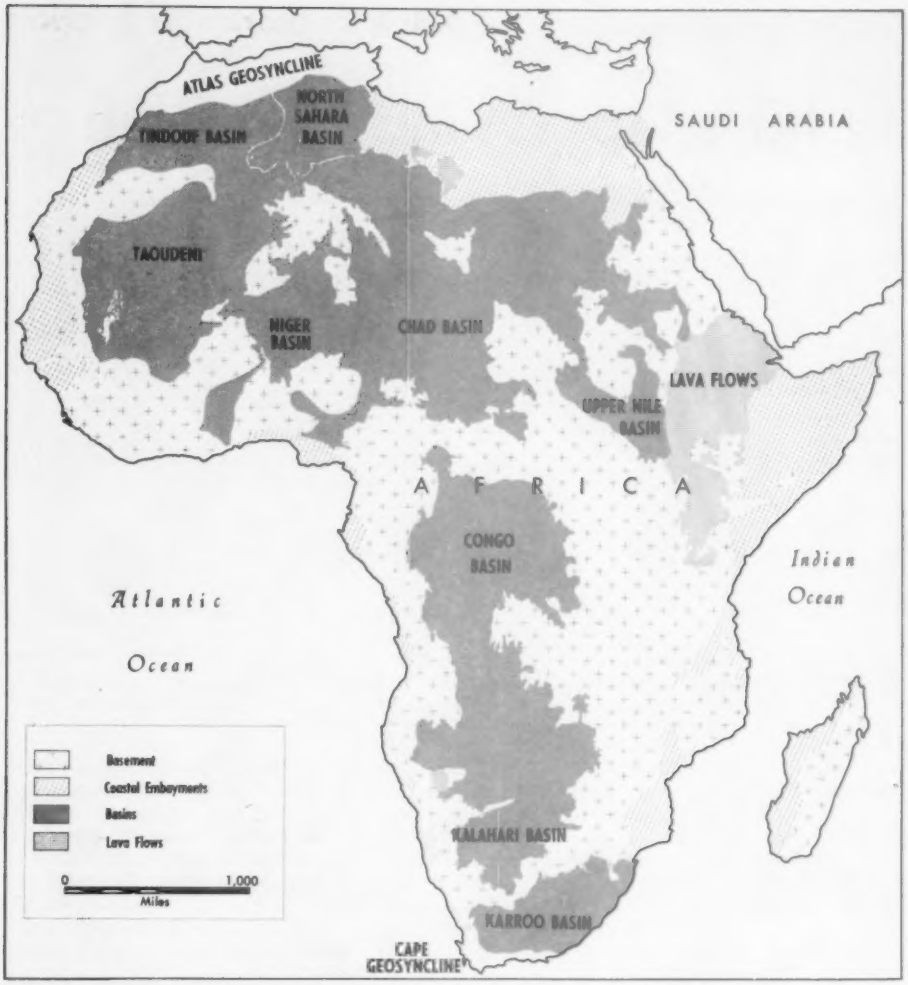
Both of these discoveries were located in fairly well-established producing areas of the basin. Then the spotlight shifted to the northern edge of a basin that is bordered by sharp anticlines associated with major uplifts, by volcanic mountains, and by great overthrusts. Upper Cretaceous and Tertiary rocks have always kept their oil secrets well in these fringe areas, but these frontiers are crumbling fast.

There are major unconformities in the Tertiary rocks of Wind River, offering tremendous potential for production. There are several thousand feet of Upper Cretaceous rocks below the thick Tertiary. None of these has been thoroughly explored. With 75% of Wind River basin still poorly explored, there should be many good oil fields lying in wait. The west and south portions of the basin, well exposed, have about 20 oil and gas fields. These have produced over 100 million bbl. of oil.

This year's drilling news on the north side has been at Squaw Butte unit, 12 miles south of Lost Cabin, when Continental Oil Co. found Fort Union Tertiary oil and Lance gas at two unit wildcats. The gasser flowed 3,200 M.c.f.d. at 6,338-54 ft. in Lance, but the oil well was not commercial (7-46 bbl. per day). Three other tests were dry.

A wave of quiet has settled over this part of the basin in the past few months. Current events seem to point to southeastern Wind River and Cretaceous rocks once again. There haven't been any new fields officially opened in this section of the basin so far this year but there are three wildcats showing indication of joining the success ladder. Several other important wildcats are digging around the eastern confines of the basin. The Wallace Creek strike should refire the on-and-off drilling interest that has settled over Wind River since last year's big push. Wallace Creek should also prove that the Muddy is still one of the biggest producers in Wyoming.

—John C. McCaslin



HERE IS the world's new major source of oil . . . Africa . . . continent of many basins, lava plateaus, and coastal embayments. Fig. 1.

Oil interest flares throughout

BY JOHN C. McCASLIN
District Editor

THE DARK CONTINENT has emerged as a major new source of world oil. Exploratory developments in the past 18 months have swept Africa on to the oil stage with new fields opening up from Gabon through the Sahara into Libya. The continent that held its oil secrets longer than any other promises to be an important coffer of the world's future petroleum reserves.

The continent of Africa for the most part is basement rock. The checked areas on the geologic map of Africa shows the areas consisting of Precambrian igneous and metamorphic rocks and Precambrian and early Paleozoic nonfossiliferous sediments. Note also the large areas masked by post-Paleozoic lava flows.

Two belts. At both ends of Africa there are highly folded and faulted geosynclines. The Cape belt in the south and the Atlas belt on the north differ sharply. The Cape belt is filled with Lower Paleozoic sediments of unfavorable facies, holding little hope for oil discovery. The Atlas belt is filled with thick sections of Mesozoic and Cenozoic marine sediments. There are many surface indications of oil as well as the old producing fields in Morocco and northern Algeria.

Interior. Interior Africa is covered with large areas of sediments. These are thick nonmarine Karroo Upper Carboniferous to Jurassic in the southern half of Africa and nonmarine Kalahari Cretaceous to Quaternary. These systems fill the Congo, Angola-Rhodesia, Kalahari, and Karroo basins. None of these has had much exploration and none has much promise of oil.

The northern interior of Africa has a thick section of marine Paleozoic sediments in basins surrounding the Ahaggar, Tibesti, and other Precambrian massifs. It is here that the prolific Sahara and Libyan discoveries of late have been made. These Paleozoics can be likened to a great section in North American continent's interior. Oil-bearing Tertiary deposits cover the rift valleys of Uganda and eastern Congo in the interior of the continent.

Embayments. All around the continent of Africa lie fringes and extensive embayments filled with marine sediments. These sediments of Cre-

WITH SABHA FORT as a backdrop, a British Petroleum Exploration Co. (Libya), Ltd., party arrives at Sabha on its way from Tripoli to Tango Camp.

Africa as strikes open new areas

taceous-Tertiary age are oil-bearing in many places. They are just a few of Africa's oil targets.

Libya

Libya holds the lead in exploratory news this year. Exploration in this country is at its peak. Here's what happened in Libya:

Mobil International brought in the 2 Hofra flowing 1,500 bbl. of 43°-gravity crude from about 3,030 ft. in April. This discovery is located 80 miles south of the Mediterranean Coast, 360 miles southeast of Tripoli. Location is on Block 11, covering 4,700,000 acres. Hofra is just south of Oasis' prolific Block 32 where Dahra field is being developed. This is Mobil's second discovery in Libya. The first was at 1 Amal in 1959. That well flowed 865 bbl. on production test from 9,841-10,405 ft. Amal is the easternmost producer in the country. It is 190 miles southeast of Bengasi and 100 miles from the coast on Block 12. Hofra 2 is the twelfth well drilled in Libya by Mobil's affiliate. The company has 75% interest in 21,000,000 acres of concessions in the country. Gelseberg interests of Germany hold the rest.

Oasis Oil Co. opened major oil production at B1-59, south of Esso's Zelten field. Block 59 is about 170 miles southeast of Dahra field. The same company also found big oil on a block of acreage in the northwestern part of the country at A1-26. Flow was 450-500 bbl. per day at about 5,725 ft. There was also 1,300 M.c.f.d. with the oil.

Oasis Oil Co. F-9 on Block 32 flowed 11,500 bbl. of oil per day from perforations at 3,066-3,106 ft. and from 3,120-30 ft. The F-9 was third biggest well completed in Libya. The big two were Zelten 1 and 2 with 17,500 and 15,000 bbl. daily.

Gulf Oil Corp. got a second oil well on its big Block 66 in western Libya at F1-66, 15 miles northwest of 1 Emgayet. The company got 50 bbl. per hour on swab from pay at 5,155 ft. Location is in the central part of the 7,194,000-acre Gulf concession. Four other area wells had shows but were not producers. The 1 Emgayet flowed 876 bbl. per day at 4,100 ft. Gulf's production here is in the same general area of the country where Oasis and Shell have oil. The 1 Emgayet is about 100 miles southeast of Oasis' A1-26 discovery on Block 26. The Gulf wells are about 150 miles southeast of Shell's 700-bbl.

IN THE AFRICAN SAHARA lie some of the world's new contenders for major oil reserves. Pipeline outlets and European demand make this one of the most attractive green oil spots on the oil globe. Fig. 2.

discovery at Bir Tlacson, Block 70.

In late summer, a 2,000-bbl. well confirmed a new major oil field for the French Sahara. Mobil International 2 Ohanet in southeastern Sahara near the Libyan border and north of the Edjele-Zarzaitine fields, flowed at the daily rate of 2,000 bbl. through ¼-in. choke from Lower Devonian sand at 7,650 ft. The extension is 4 miles north of 1 Ohanet. It is structurally higher than the discovery well which flowed 1,900 bbl. per day on 1-in. choke from 7,740 ft. This two-well field is 350 miles south of the coast, but only 30 miles west of the Edjele pipeline, which will move French-Shell oil 460 miles to the Tunisian shore near Gabes. The well is the first in the Sahara involving an American company. Mobil is earning a 25% interest in the 8,700,000-acre block on which the Ohanet wells are located. This block belongs to Cie. d'Exploration Petroliere (CEP), the French government-controlled exploration company which is the operator.

September developments included stepouts to two Libyan discoveries. American Overseas, jointly owned by Texaco and California Standard, made 750 bbl. of oil on a 10-hour open-flow test at the B6A in Beda field. Pay was at 4,124 ft. The firm then moved in a rig for E1-47, and logged its A1 well in Concession 46 at 11,731 ft.

Libya Shell completed A3 well, Block 70, as an 18-bbl. per hour well at 7,750 ft. Three other rigs are doing wildcat work. A1 on Block 41 is drill-

A BP SURVEY party leaves base camp to carry out seismic operations in the salt flats area of the Fezzan, North Africa.

ing below 12,787 ft., B1 is reaming at 590 ft. The third rig is moving in for B1, Block 39. Oasis Oil Co. has eight outfits drilling outside Block 32, where four rigs are operating. Three units are assigned to Block 26, one to Block 30, one to Block 33, and one to Block 59. Nelson Bunker Hunt, the last of the original concession holders to start drilling, is below 11,027 ft. at A2 in Block 2, northern Cyrenaica. A German firm, Deutsche Erdoel, is rigging up at its first test in Concession 77, Fezzan. Esso Libya has two field-work rigs going in Zelten field. A wildcat is drilling at Tedma on Block 6. Esso Sirte is moving two more outfits into Block 17. A2 is drilling ahead here. Mobil has three active rigs. The D1 well in Block 13 was quit at 6,700 ft. and the outfit is going to Block 72. Another well is going on Block 13, and the third rig is drilling at Hofra. British Petroleum has wells under way in Blocks 34, 35, and 80. Gulf is drilling ahead in G1 on Block 66 in the Hamada.

Royal Dutch-Shell has increased its acreage interest in the French Sahara with the award of 4,525-sq. miles of concession southeast of Hassi Messaoud field to CPA.

Shell has 65% interest in CPA, which must spend $6,500,000 in exploration in the Lejamate permit in the next 5 years. British Petroleum added to its Saharan rights with the grant of the 309-sq.-mile Hass Izi permit to Petroles de Valence. The company must spend at least $253,000 in 3 years. These awards were among nine recently made by the French Government to individual firms or groups that included an Italian group, two German companies, and one Canadian-based company.

1959 African Highlights

Last year was the big year for African oil hunting. 1960 appears headed for even greater honors. Production in 1959 increased 36% over the previous year—the increase brought about by the big Algerian Saharan output, Nigeria, and Gabon. The Sahara output was three times greater than in 1958. Nigeria's output more than doubled.

Two new nations. Two new producing countries were added to Africa's oil fold. Senegal and Cameroun both had discoveries. This brings the African producing total to nine countries.

Algerian Sahara. There were seven new oil fields found in the Sahara. The most important find was at Hassi Mazoula. Other important field openers were Ouan Taredjeli, In Akamil in the Fort Plignac basin, and Hassi el Gassi in the Triassic basin.

African statistics

TOTAL AFRICAN FOOTAGE DRILLED — 1959

	ft.
Algeria	1,138,793
Angola	173,109
Cameroun	1,258
Congo	63,480
Egypt	210,970
Gabon	228,934
Ivory Coast	14,321
Kenya	4,138
Libya	343,321
Madagascar	38,252
Morocco	73,545
Nigeria	537,387
Senegal	80,243
Somalia	24,195
Somaliland	22,337
Tanganyika	625
Tunisia	21,123
Zanzibar	8,430
Total	2,984,461

ACTIVE AFRICAN RIGS
October 1960

Algeria	43	(16 on wildcats)
Angola	5	on wildcats
Egypt	12	—some on offshore
Gabon	4	wildcats
Libya	33	
Nigeria	6	
Senegal	4	(2 on wildcats)
Somalia	1	wildcat going
Somaliland	1	wildcat going

CURRENT AFRICAN OIL OUTPUT
(1,000 bbl.)

	June 1960	June 1959	+ —
Algeria	153.6	19.2	+134.4
Angola	1.2	0.9	+ 0.3
Egypt	59.9	58.4	+ 1.5
Gabon	15.0	14.6	+ 0.4
Morocco	1.9	1.9	0
Nigeria	15.5	9.0	+ 6.5
Total	247.1	104.0	+143.1

WELLS COMPLETED IN 1959

(Field wells)	Oil	Gas	Total	% success
Algeria	103	1	113	92
Angola	5	0	9	55
Congo	4	3	10	70
Egypt	29	0	31	94
Gabon	20	1	24	87
Morocco	8	1	19	47
Nigeria	16	0	16	100
Total	185	6	222	86
Wildcats				
Algeria	7	4	37	30
Angola	2	0	10	20
Cameroun	1	0	1	100
Congo	0	0	1	0
Egypt	1	0	2	50
Gabon	1	1	19	10
Ivory Coast	0	0	1	0
Kenya	0	0	2	0
Libya	14	3	41	41
Madagascar	0	0	3	0
Morocco	0	0	3	0
Nigeria	9	3	37	32
Senegal	1	2	11	27
Somalia	0	0	2	0
Somaliland	0	0	5	0
Tanganyika	0	0	1	0
Tunisia	0	0	5	0
Zanzibar	0	0	4	0
Total	36	13	185	26

AFRICA'S OIL OUTPUT

	1959 bbl.	Cum. prod. 1-1-60
Algeria	9,190,770	15,301,820
Angola	358,110	849,665
Egypt	21,579,258	301,221,624
Gabon	5,530,203	9,291,203
Morocco	717,716	7,173,371
Nigeria	4,096,000	5,984,334
Total	41,472,057	339,821,963
...AND GAS FLOW (M.M.c.f.)		
Angola	92	215
Morocco	146	1,313
Tunisia	223	1,058
Total	361	2,586

There were 113 field wells completed in Algeria last year, and 37 wildcats. The 24-in. pipeline from Hassi Messaoud to Bougie increased the giant output from Hassi Messaoud.

Success ratios remained high in the Fort Polignac basin and El Biod uplift. In the basin there were nine wildcats drilled, three oil and two gas, four dry. The discovery at Ouan Taredjeli was made on a nose closed by faulting on the flank of Zarzaitine field. There were discoveries in the Lower Devonian at Hassi Mazoula in the western part of the basin. Wet gas production was tapped at Hamra on an anticline located at the foot of the El Biod uplift. There were 40 wells drilled at Zarzaitine last year, 31 at Edjeleh.

Northwest Triassic basin. Drilling interest centers in the southeast part of this basin. Objective is finding the Hassi Messaoud extension trend. Early in the year Hassi el Gassi was opened by SNPA. Production is from Cambrian. Southeast of El Gassi 70 km. COPEFA found gas at Hassi Touareg in the Ordovician. Field is on an elongate anticline located on the north extension of the El Biod uplift in the Triassic basin.

There were 33 wells drilled at Hassi Messaoud last year. There are 51 producers in the big field now with the producing area covering more than 7,000 acres.

Angola. Drilling continued in the Cuanza basin of Angola. Petrofina found oil at Galinda. A Gulf Oil Corp. subsidiary did considerable exploring in the Angolan enclave of Cabinda.

There were five oil wells completed in the Benfica and Cacuaco fields. There were two oil discoveries on the Bom Jesus and Galinda structures. The 2 Galinda discovery highlighted the year's news with 314 bbl. per day from the Aptian limestone.

THIS BP CREW loads a shot-hole drilled by a mobile rig in Libya's desert lands, preparatory to one of the many seismic operations under way in North Africa. It cost millions of dollars for oil companies to clear World War II land mines from the desert before seismic work could begin.

Cameroun. This country got its first production at SPAEF's Kwa - Kwa wildcat.

The Kwa-Kwa discovery, 24 miles south of Douala, flowed 100 bbl. of oil per day from rocks of Eocene age at 3,829 ft.

Egypt. This nation is still the biggest producer in Africa, accounting for 42% of the continental production. An important discovery was made at COPE's Sidri wildcat. Most of the nation's drilling was inside four oil fields discovered in the past few years at Belayim, Abu Rudeis, Ras Bakr, and K'reim. Egyptian production is now supplemented by Ras Bakr field which went into commercial production last March. The government-operated field in June 1960 averaged 5,000 bbl. per day from 15 flowing wells. Location is on the mainland near the Red Sea.

Gabon. This nation is busily engaged in exploratory work. Shell and Mobil are participating in parts of SPAEF's large concession in the country. There were 43 wells drilled last year compared to 9 the previous year.

Libya. Here is the location of Africa's most important discovery last year—Zelten. Esso drilled the discovery well in the Sirte basin in the east-central part of the country. There were 16 other discoveries out of a total 41 wildcats drilled. Seven of these flowed more than 900 bbl. per day.

Exploratory interest shifted from western Tripolitania and Fezzan to the eastern Sirte basin of Tripolitania and North Central Cyrenaica, caused by the big strike at Zelten by Esso. That well, C1-6, flowed 17,500 bbl. per day from Paleocene limestone. Three other wildcats drilled here were discoveries with production at 2,500 to 15,000 bbl. per day. Amoseas B1-47 Beda, another Tertiary discovery, flowed 3,650 bbl. per day. B2-47 Amoseas flowed 660 bbl. per day. Oasis continued to develop Concession 32 with discoveries at F1-32, F2-32, and B3-32. All three wells flowed from 500 to 8,000 bbl. daily. Mobil's B1-12 Amal flowed 990 bbl. per day from Paleozoic quartzitic sandstones. Libyan American A1-17 found oil in the Cretaceous and Paleocene. The well flowed 500 bbl. from Cretaceous and 100 bbl. daily from Paleocene. The B1-17 well flowed 912 bbl. from Paleocene.

In western Tripolitania, Shell Oil Co. completed A1-70 for 700 bbl. per day from Paleozoic, opening first oil production in this area. The only discovery in Fezzan Province was Gulf's A1-66 which flowed 888 bbl. per day from Paleozoic sandstones.

Nigeria. Shell - BP had nine new field discoveries out of 37 wildcats tried in this country.

Senegal. This country became a producer with three discoveries near Dakar by SAP.

Spanish Sahara. The rush for concessions featured activity in this part of Africa. The Spanish Parliament enacted favorable oil legislation last year, causing 21 companies to field bids on 36 permits. All 36 tracts have been awarded.

One noncommercial gas pool was found in Dakar. Better results were reported 19 miles east of the City at SAP DN-2. This well found gas and the DN-4 well found oil in the Senegal-Mauritania basin. The Diam Niade-2 well was completed in a faulted block on the west flank of the big N'Diass anticline at 2,942-85 ft. Gas flowed at the rate of 3,530 M.c.f.d. from Upper Cretaceous sands. The DN-4 well found 50 bbl. of oil in 4 hours at 3,332-59 ft.

Data from AAPG July Bulletin 1960 and The Oil and Gas Journal. Photos courtesy British Petroleum Co., Ltd., London.

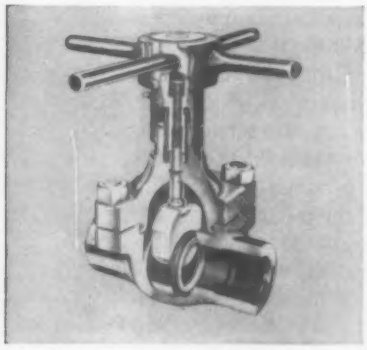
"It's a good feeling to know we have Edward Mudwonder Valves on our #10 rig"

Johnny Sharon, Drilling Superintendent for the Power Rig Drilling Company of Lafayette, Louisiana, has had a lot of experience with Edward Mudwonder valves. Recently we talked to Johnny at Land Rig #10.

"As far as we know," Johnny said, "our #10 rig is the most powerful rig in Louisiana, and it's as versatile as a rig can be. We can drill competitively at anything from 12,000 to 25,000 feet because the rig is designed for versatility, and the equipment on it is selected for rugged, dependable duty. Mudwonder valves give us just that kind of service.

"We have replacement gates and seat inserts on hand, but it's a good feeling to know that we probably won't have to use them. My experience with Mudwonder valves on this new rig bears out the experience I've had on other rigs. That's why #10 is an all-Mudwonder rig, from mud tanks through stand pipe."

This confidence in Edward Mudwonder valves is found wherever you go in the drilling fields. Mudwonder valves are built in 2", 3" and 4" sizes, with screwed or flanged ends, for 2000 psi WP (4000 psi test) and 3000 psi WP (6000 psi test) service and in 2" size for 5000 psi WP (10,000 psi test) service. See your favorite oil field supply store, or write Edward Valves, Inc., East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. 6018



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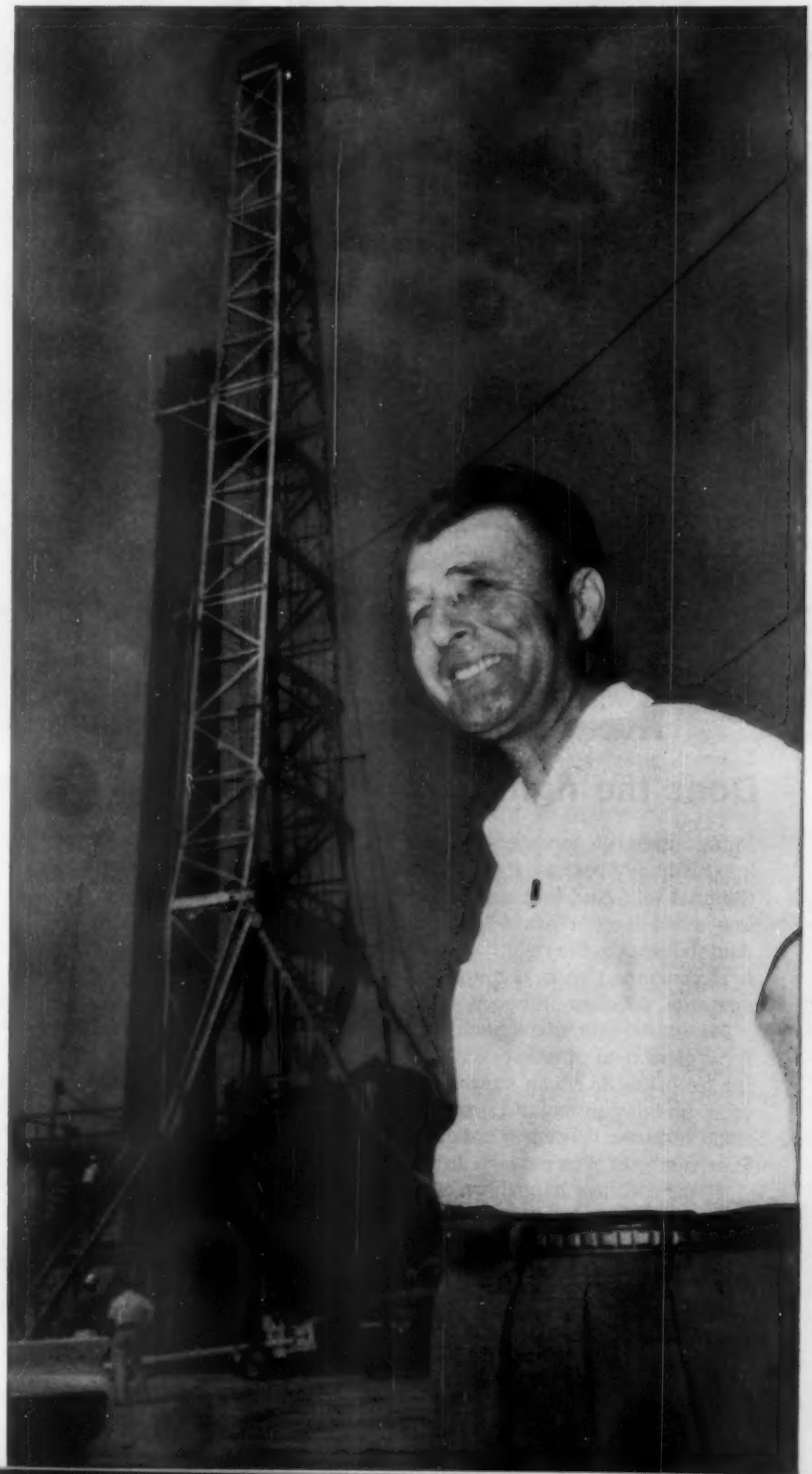

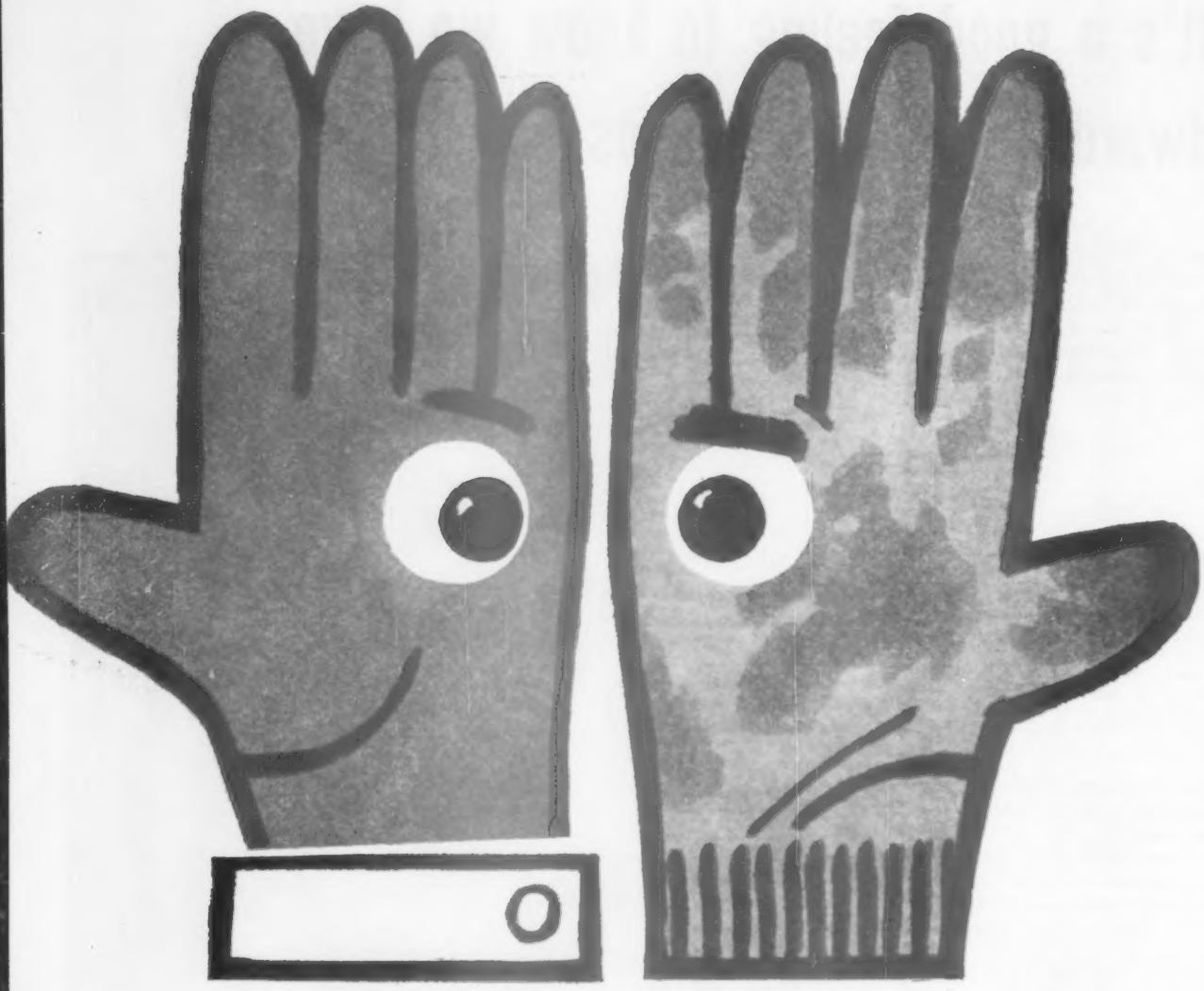

Does the right hand know what the left hand is buying?

Many times in mud buying the smiling left hand is happy because it is concerned only with the mud bill. And that can be kept low. But, a low mud bill often means low drilling efficiency. And that makes the right hand unhappy because it is concerned with keeping the *total* drilling operation efficient and economical.

An inadequate mud system can be responsible for a great deal of unnecessary expense in drilling an oil well. It can cause extra round trips, more bits. It can mean a slower rate of penetration, and time wasted in conditioning the mud. Poor mud can even damage the productive zone.

If these things happen on your wells with a fair degree of consistency, why not review the way "your hands" buy drilling mud. A well planned Magcobar mud program *may* cost a little more than a *cheap* mud program (although it will likely cost even less), but it can and will reduce your over-all drilling cost. It may even help you increase your production!

A *cheap* mud program may be the most expensive single item on your wells. A Magcobar planned mud program, on the other hand, assures the right use of the right products, makes full use of the money-saving advantages of Magcobar Technology. So, why not get all of your hands working towards the same objective? Let Magcobar plan with you to get the best wells at the lowest *total* cost.

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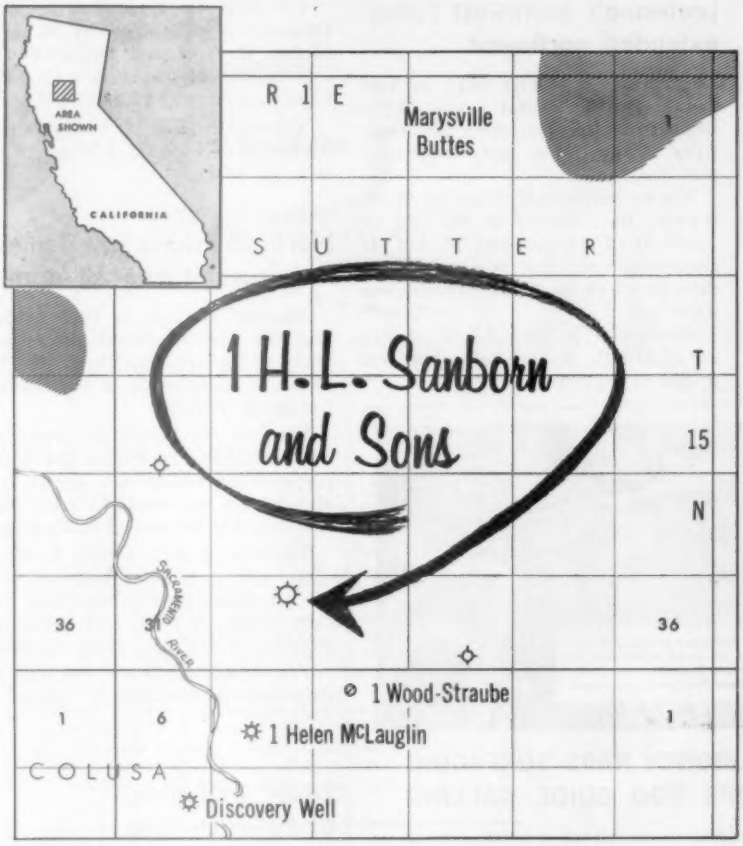

THERE IS new gas production in a highly promising Sacramento Valley area.

In California

Long extension flows in Sutter

IN CALIFORNIA'S Sacramento Valley, Cameron Oil Co. and Franco Western Oil Co. have drilled a new pool discovery which has moved production 1½ miles northeast in Grimes gas field, Sutter County.

The 1 H. L. Sanborn & Sons in 32-15n-1e flowed at the rate of 9,700 M.c.f.d. from two zones. The well flowed at the rate of 4 M.M.c.f.d. during a 4-hour test of the upper zone at 5,492-5,520 ft. During a 3½-hour test of the lower zone at about 7,000 ft., flow was estimated at 5,700 M.c.f.d.

The operators apparently have extended production in the field to the east, based on drill-stem tests of another well. The 1 Wood-Straube in 4-14n-1e flowed 3,200 M.c.f.d., 2,400 M.c.f.d., and 4 M.M.c.f.d. on drill-stem tests of three zones down to 6,651 ft.

Both wells are north of the 1 Helen McLaughlin, a deep pool discovery which is considered the best gas well found in California this year. The McLaughlin well (5-14n-1e) tested 33 M.M.c.f.d. on a series of tests of seven zones in the F zone. The well has been dually completed for about 5 M.M.c.f.d.

The Sanborn well, drilled to a total depth of 8,102 ft., is shut in. The 1 Wood-Straube is drilling ahead below 6,750 ft.

Two more discoveries. In Colusa County just west of Sutter County, two apparent gas discoveries have been made.

Western Gulf Oil Co.'s 1 Goff-Erdman in 15-13n-1e, was good for 5 M.M.c.f.d. during a drill-stem test at 7,503-46 ft. The Gulf well is in Buckeye East field about 3½ miles due east of Buckeye gas field. Gulf has three producing wells in Buckeye, which was discovered in January.

Universal Consolidated Oil Co.'s renewed interest in the Sacramento Valley gas search apparently has paid off with its 1 Rheem-Hammer in 5-17n-1w.

The well reportedly flowed gas on a test of an interval at 2,315-38 ft. The well is approximately 7,000 ft. northeast of the nearest gas production in Compton Landing field.

Etosha will look over South West Africa

A large African exploration concession was reported last week by Texas Eastern Transmission Corp. The exploratory tract, which covers about 90,000 sq. miles in the Territory of South West Africa, was made to Etosha Petroleum Co., a wholly owned subsidiary of Texas Eastern, by the territorial government of South West Africa.

Etosha Petroleum's concession covers all but a small segment of the land between the twentieth parallel and the country's northern boundary and west of the twenty-first parallel to the Atlantic Ocean. The 90,000-sq.-mile concession would roughly correspond to the combined areas of Indiana and Illinois. Nearest oil and gas production is in Angola, part of Portuguese West Africa, which adjoins the concession on the north.

Texas Eastern is now engaged in a preliminary geological reconnaissance program to determine whether the oil prospects here merit a broad geological and geophysical study.

The Territory of South West Africa is administered by the Union of South Africa, operating under a mandate issued by the defunct League of Nations. The country is evenly divided between desert, mountains, and high plateaus. This new concession covers mostly table land area, but has some desert and mountain terrain.

Pair of wildcats slated in Arizona

Two wildcat locations, one in Apache County and the other in Cochise County, have been staked in Arizona.

One of the wells, Superior Oil Co.'s Navajo M-23-21, actually will be a 1-mile stepout of the company's gas and condensate discovery completed early last year. The new test, slated to go to 6,600 ft., will be located in 21-41n-30e. This is a mile south of Superior's Navajo 14-16.

The 14-16 flowed 12,500 M.c.f.d. of gas and 100 bbl. of 64.8° condensate from perforations in the Upper Boundary Buttle and Desert Creek formations. The discovery was perforated at 4,099-5,032 ft., 5,035-40 ft., and 5,063-71 ft.

The other new location is a rank wildcat test which will be drilled by Key Petroleum Exploration Co., a Phoenix firm headed by Albert R.

Russell and Charles D. Northup. The Key 1-C will go to 6,800 ft. in 5-21s-24e. The location is approximately 10 miles southeast of Tombstone and 15 miles north of Bisbee.

Simpson oil found at Kansas wildcat venture

Pratt County has new Simpson Ordovician production at E. K. Edmiston 1 Gates in NW NE 28-28s-13w, about 1 mile southwest of dry Hertlien field.

Discovery well pumped 120 bbl. of oil daily from perforations at 4,418-23¼ ft.

Louisiana's southwest Esther extended northwest

Southwest Esther field, in Vermilion Parish, coastal Louisiana, is being extended 1¾ miles northwest from its discovery, and, until now, only well.

The extension well, drilled by W. T. Burton, Inc., flowed at the rate of 2,600 M.c.f. of gas and 26 bbl. of condensate per day while testing through 10/64-in. choke. Pressure was 4,000 psi.

Production is from 12 ft. of pay at 11,838-50 ft. in hole that was drilled to 20,014 ft.

The field was discovered in 1958. Discovery well, drilled by R. Mosbacher, H. Hurt, and Union Oil Co., was dually completed in sands at 12,416-34 ft., and 12,900-10 ft.

The well, 3 Miller, is nearly ¾ mile northwest of Burton's 2 Miller, a dry hole.

North Louisiana salt domes face assault attempt again

Another attempt to find production on one of North Louisiana's many so far unproductive known salt domes is being made in northeastern Catahoula Parish.

Location for Breuer & Curran Oil Co.'s new 5,000-ft. Wilcox test in that parish is on Foules salt dome. It is about a mile northeast of Foules townsite, and 3 miles east of Sicily Island.

The test, 1 Mrs. Carrie L. Hagedorn, also is a mile northeast of a wildcat drilled by Pan American Production Co. in 1947, and abandoned in salt at 6,285 ft., proving the dome.

Pan American's test had teasing gas showings in the Sparta, topped at 1,908 ft.

Texas well aims at Edwards lime

Edwards lime is the objective of a new deep wildcat being started by Shell Oil Co. in northwestern Bee County, in Texas' central coast area.

The test, 1 Alvin L. O'Neal, will be the first in Bee County to explore the Edwards horizon, and one of the most coastward and downdip so far drilled. Projected depth is 17,500 ft.

Location is 3 miles south of Pawnee, 3½ miles northeast of the Live Oak county line, and 6 miles south of the common Atascosa-Karnes county line. It is 15 miles southeast of Fashing field, nearest deep-Edwards production.

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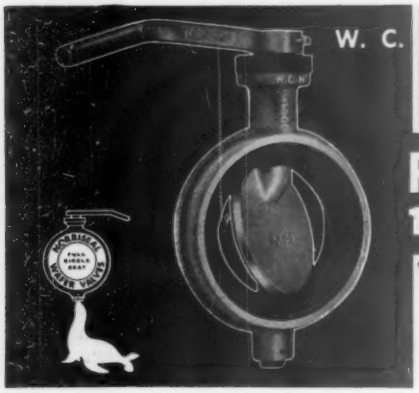

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P. O. Box 1739, Tulsa

WALLACE CREEK is the first big oil discovery in Wind River basin since the opening of the Grieve unit about 5 years ago. Discoverer is National Cooperative Refinery Association. Well is the 1 Wallace Creek unit in SE NW 22-34n-87w, Natrona County, Central Wyoming. A drill-stem test at 10,333-74 ft. in the Muddy zone of the Thermopolis shale of Cretaceous age gave 59 bbl. per hour or 1,416 bbl. daily. Nearest production is at Cooper Reservoir, a Tertiary Fort Union gasser 8½ miles north. Location of Wallace Creek is 11 miles southeast of Raderville, 17 miles northwest of Grieve, another Muddy producer, 14 miles southwest of Boone Dome gas field.

Pennsylvanian is New Mexico target

THE RISE of Pennsylvanian importance in southeastern New Mexico exploration continues brisk. El Paso Natural Gas Co. 1 Lusk Deep unit, a 14,200-ft. test in southwestern Lea County, 49 miles west of Hobbs in 19-19s-32e, ½ mile northeast of shallow Lusk Delaware sand field, flowed 98 bbl. of oil in 2 hours through ¼-in. choke on a drill-stem test at 11,148-98 ft.

Gas volume on the above test was 8 M.M.c.f.d. An earlier test in the Pennsylvanian at 11,115-48 ft. got 4 M.M.c.f.d. and 48 bbl. of oil per hour on ½-in. choke. It then reversed out 100 bbl. of oil. This wildcat first got into the wildcat news when it flowed oil from the Bone Spring at 5,757-8,825 ft. That test got 21 bbl. per hour. There was also oil recovery in the Wolfcamp Permian at 10,408-69 ft.

Other Lea news. About 4 miles north of Lovington, Columbia Carbon Co. 1 D. M. Crockett was completed as a Wolfcamp Permian discovery. The well, originally a Devonian producer in Caudill field, flowed 220 bbl. of oil per day from Wolfcamp at 10,586-10,606 ft. on 13/64-in. choke. This well is in 21-15s-36e.

Eddy County. Ohio Oil Co. 1 Ethel V. Noel, south offset to a new Pennsylvanian gas field discovery well in Eddy County, flowed 3,100 M.c.f.d. from perforations at 8,992-8,100 ft. on 19/64-in. choke. The discovery well of the field was the 1 Armquist in 20-18s 26e.

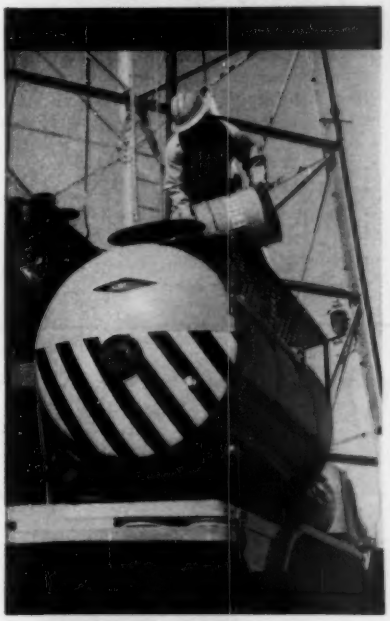
Interest picks up in Northwest Michigan

In Michigan B. G. Hilliard and W. L. Harvey, Mt. Pleasant independents, spudded 1 Kraft, NW NE NE 30-19n-17w, Mason County, a projected 5,000-ft. Niagaran-section wildcat, the newest indication of increasing exploratory work in the northwestern part of the state.

Location is 3 miles east of a 1952 test that bottomed at 6,622 ft. and has been tested extensively over the years for gas in the Salina-Niagaran formation. Permit for the wildcat was one of 16 approved for the week by the State Geological Survey.

Bell and Gault Drilling Co. 1 Young, NE NE NW 11-8s-1w, Hillsdale County, on preliminary pump

WATER BLOCK?



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tests recovered average 33 bbl. day from Prairie du Chien pay at 3,466 ft. A northeast diagonal offset was spudded.

Located 15 miles southeast of the south tip of the Scipio-Albion trend Trenton-Black River field and less than 10 miles from the Ohio State line, the outpost so far has caused only cautious interest in the trade.

Drilling continues in NW Montana

EXPLORATORY interest in the Disturbed belt of northwestern Montana continues despite lack of success in recent years.

There are four wildcats drilling in the belt with others planned soon. Three of these drilling are in Glacier County, one in Teton County, spanning 80 miles from 25n-8w, Teton County, to 37n-14w, Glacier County. Very few wells have been drilled along or on either side of this long trend.

In Glacier County, Great Northern Drilling Co. is drilling a 9,100-ft. Madison Mississippian test at 1 Two Medicine unit in SE NW 19-31n-11w, on the 22,506-acre Two Medicine unit. This well is drilling below 8,258 ft. Location is 6 miles east of East Glacier town. Great Northern also plans drilling in 32n-10w and 30n-10w.

Gulf Oil Corp. and Pan American Petroleum Corp. are drilling below 3,080 ft. at 1 East Glacier-Blackfeet in NE SW 3-30n-12w, Dawson Lake area, 4 miles south of Great Northern's well. This also is due to the Mississippian at about 9,300 ft.

To the north near Canada Superior Oil Co. is drilling a 12,700-ft. Madison wildcat at 23-19 Blackfeet-Tribal in C NE SW 19-37n-14w. Drilling is now below 7,739 ft. In Teton County, Shell Oil Co. is running tests after reaching total depth at 4,911 ft. at the 14-34 Unit, SW SW 34-25n-8w. Location is on the Little Deep Creek unit.

Wyoming's Patrick Draw adds new west extension

A gas well 1 mile west of production on the west side of prolific Patrick Draw field in Sweetwater County, Green River basin, Wyoming, is shut in.

This new extension success is El Paso Natural Gas Products Co. 34 Unit in NW SE 4-18n-99w. The only gage reported was 104 M.c.f.d. on a drill-stem test at 4,129-70 ft. in Almond.

At the north end of this area, Forest Exploration Co. 11 Government-Arch 12-1 shut in the northernmost location on the trend. The well, located in C SE SW 12-19n-99w, flowed 90 bbl. of oil in 23 hours on 20/64-in. choke from Almond sand at 4,671-93 ft.

Arkoma's Brazil anticline will have deep wildcat

A 12,500-ft. wildcat is planned for southeastern Oklahoma's Arkoma basin. The new try is Midwest Oil Corp. 1 Goldsborough in SE SW NE 31-7n-23e, extreme western LeFlore County.

The wildcat will be drilled on the Brazil anticline 5 miles northeast of Midwest's new gas field in 6n-22e, Latimer County. This anticline is about 13 miles long. Midwest has already opened production in Red Oak and Spiro sands on the central part of the feature.

Lincoln County. Other Oklahoma activity includes Hunton Siluro-Devonian gas production at Loyd Benefield and Brooks Hall 1 Bill Adams in NE SE NW 4-14n-2e, 2 miles northeast of West Wellston field and 2 miles northwest of the town of Wellston. The well flowed 30 M.M.c.f.d. from Hunton perforations at 4,928-33 ft.

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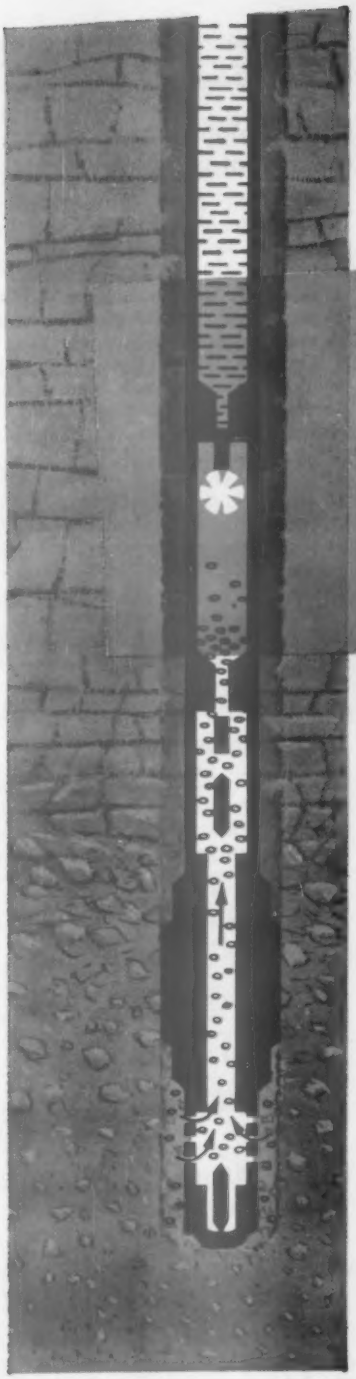

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Closed-in pressure	566 psi

Since all formation pressures were less than the hydrostatic pressure of the water cushion, it is obvious that, without the use of the New Halliburton Back Pressure Valve, no formation pressure would have been indicated and this potentially productive zone might have gone undetected.

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Deep Texas well finds new field

Exploration along the upper end of the Deep-Edwards trend through Texas' central coastal region has resulted in the discovery of another indicated good oil field.

The discovery is by Standard Oil Co. of Texas at its 1 Manka Guardian 2, 5 miles northwest of Karnes City, in Karnes County.

It is 4½ miles southwest of the developing Persons Deep-Edwards field, and 13 miles northeast of, and on a line with, the expansive Fashing field crossing the Karnes-Atascosa county line.

Discovery well flowed at the rate of 5 bbl. of oil per hour during a 3-hour test through 20/64-in. choke. Although gas volume was not gaged, a low gas-oil ratio was indicated. Flowing pressure was 250 psi. Its pay is perforated at 10,918-43 ft.

The new field is the fourth in 20 Deep-Edwards fields so far found to produce oil. The list includes the relatively new Persons field with 25 wells; Fashing (one well), and a new field opened last week (OGJ, Oct. 3, p. 69) by Standard Oil Co. of Texas in southwestern DeWitt County, near the Karnes county line. Other Deep-Edwards fields, including Fashing, have been productive of gas, and, in some cases condensate.

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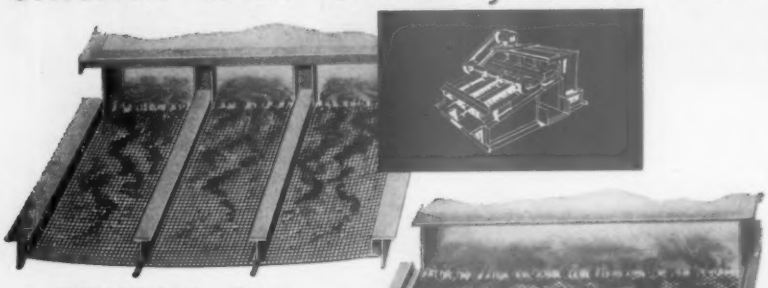

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Texas' Matagorda adss dual producer

A prolific dual-zone oil discovery has been made by Humble Oil & Refining Co. in Matagorda County, on the Texas Gulf Coast.

Discovery well has a combined oil-flow potential of 611 bbl. daily through ⅛-in. chokes.

The well, 1 J. C. Lewis, is 3 miles south of Buckeye, and about a mile southeast of Wilson Creek field. It was drilled to 11,709 ft. Completion is in sands at 10,612-20 ft., which tested 316 bbl. daily; and 10,652-70 ft., which made 295 bbl. daily.

Gas-oil ratio from the shallower zone is 3,063 cu. ft. per bbl.; flowing pressure is 5,325 psi.; and gravity of the oil 47°.

From the lower zone, the ratio is 3,125 cu. ft. per bbl.; flowing pressure 5,250 psi.; and oil-gravity 46.5°.

New Texas field adds second well

The newly opened South Francitas are in southeastern Jackson County, in the Texas coastal area, has its second oil well with production from a shallower sand than that of the oil-discovery well.

The new well, Texaco Inc., 5 Weed, a 1,320-ft. location southwest of 4 Weed, the oil-discovery well, is completed through perforations at 8,720-32 ft. It is rated good for 178 bbl. of 36.6°-gravity oil daily, flowing through 9/64-in. choke with pressure of 2,200 psi.

Discovery well, completed last June, is productive in sand at 8,960-70 ft.

Lisbon extension flows 20 bbl. per hour in Utah

Utah's Lisbon field has an indicated new producer at Pubco Petroleum Corp. 1 Lisbon-Federal, C SE SW 12-30s-24e, San Juan County.

The well flowed 20 bbl. per hour on test of Mississippian at 8,550-8,672 ft. through 20/64-in. choke. Location is 2 miles southeast of the field. There is a 345-ft. pay section in the well, considered to be one of the best Mississippian prospects in the field to date.

Pure Oil Co. 2 Northwest Lisbon-U.S.A.-A, NE SW 10-30s-24e, 1 mile southwest of the field discovery well, flowed 211 bbl. of oil on 24-hour test through 24/64-in. choke. Flow was from McCracken Devonian at 8,254-8,330 ft.

Two-volume oil review of Andrews County ready

A two-volume petroleum review of West Texas' Andrews County is available from Phifer Petroleum Publications, Box 6014, Houston. This is a complete rundown on the 185 oil fields in this West Texas county. The individual fields are illustrated with electric logs, structure maps, and other pertinent charts. There is also a complete production record of Andrews County's fields through December 1959.

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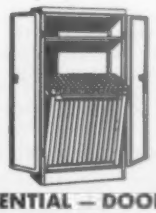

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Dates for log school changed

A previous announcement, setting dates for a Tulsa log school in late November and a Dallas school in January 1961, has been changed. The schools have been advanced to earlier dates.

The Tulsa school is scheduled for October 24 through November 3, 1960, at the Tradewinds Motel, Room 102. Registration is well along, with major companies and independents participating.

The Dallas school is scheduled for November 28 through December 8, 1960, location to be announced later. Response to the recent announcement has been excellent; many requests for registration information have been received and registration for this school will be completed at an early date. Contact R. G. Hamilton, Hamilton Well Log Consultants, P. O. Box 7293, Tulsa 5.

Arkoma basin strikes indicated

SOUTHEASTERN Oklahoma's Arkoma basin has two indicated discoveries, one of them a tight hole. Permeable zone was reported at W. R. Yinger and King-Stevenson Oil Co. 1 Malarnee in SE NE SW 24-2s-13e, Atoka County.

A core in the Stanley sand at 1,712-45 ft. bled oil and gas. Permeability was 6-8% showing 14 md. Porosity ranged from 18-plus down to 14%. This wildcat is northeast of Potato Creek shallow field and is northwest of an indictaed discovery in now-barren Pushmataha County. There, J. F. Stephenson and King-Stevenson 1 Brame, C NW SE 15-3s-15e, reportedly has found some production. There are reports of outlet facilities already being worked out. If this Pushmataha County wildcat is a discovery, first production would be opened in the county and in the vast Ouachita Mountain geosyncline.

Perry County, Ohio, strike is completed

In Ohio a 400-bbl. strike that also gaged 1,200 M.c.f.d. of gas 1 week after fracture was completed by Ridgedale Oil & Gas Co. in Pike Township, Perry County.

The 1 J. B. Shahan, Section 30, found the Clinton sand at 3,304-43 ft. with a showing of oil natural and 50

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M.c.f.d. of gas. Shut-in rock was 925 psi.

This test marks the fifth straight success in the new pool opened by Frank Walsmith.

A reentry in the shallower formations west of Zaleski in Madison Township, Vinton County, resulted in a producer that tested 100 bbl. of oil per day with 600 M.c.f.d. of gas in 24 hours.

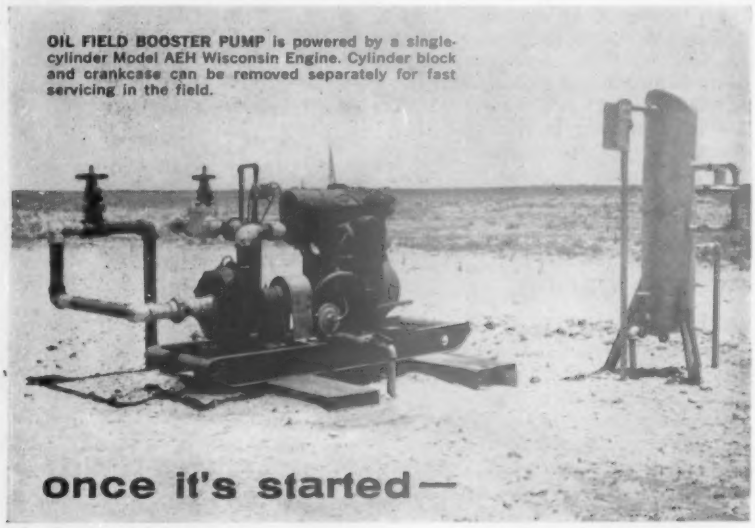
The Berea sand of 1 Rebecca Delong, Section 36, was fractured with 200 bbl. of oil and 5,000 lb. of sand at 947-53 ft. The operator, Kay Drilling Co., have three additional locations drilling in the area that hasn't had any activity since 1917.

Triple completion reported at Oklahoma field well

The Woodford is a new pay in Joiner City field, Carter County, southern Oklahoma. Trice Production Co. 1 Hester, NE SE 12-5s-3w, flowed 300 bbl. of oil per day on 16/64-in. choke from perforations at 8,720-8,906 ft.

The well also has two other pay zones. From Chimney Hill Siluro-Devonian at 7,820-50 ft. the well flowed 400 bbl. of oil in 24 hours through 20/64-in. choke. From Bois d'Arc Siluro-Devonian at 9,000-9,100 and 9,524-66 ft. the well flowed 245 bbl. in 24 hours on 24/64-in. choke.

Seminole County. A shallow area in East Central Oklahoma gained a high-flowing producer. It is C. L. Cluke Myers Drilling Co. 2 Willmot, NE NW NW 30-6n-8e. The well flowed 340 bbl. of oil and 14 bbl. salt water per day on 1-in. choke from open hole in Calvin sand at 913-23 ft. This is location in the linkup area at East Sasakwa and Fish fields.



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Tests under way at fourth Wyoming well

Production tests are reported at the fourth well in a new field south of Miller Creek field in Crook County, Powder River basin, northeastern Wyoming.

U. S. Smelting, Refining, & Mining Co. 4 Kummerfield, C NW SW 32-51n-68w, flowed 66 bbl. of oil in 3 hours through ¼-in. choke in the Dakota Cretaceous at 6,087-6,102 ft. Test is through 12/64-in. choke. The fifth well in the field, 5-32 Kummerfield, C SW NW 32-51n-68w, is drilling below 3,382 ft. There are four other locations in the field staked by Trigood Oil Co.

Completions mount in Arkansas' Sandy Bend

Completion of three more wells raises to 24 the number of producers in the shallow Sandy Bend field of Union County, southern Arkansas. Three additional wells are in process of completion.

The wells are a joint operation of Olin Oil & Gas Corp. and Sinclair Oil & Gas Co. on fee minerals. They are productive from a 60-ft. section of Nacatoch sand at depths around 2,400 ft.

New wells are N-18 Olin Fee, pumping 37 bbl. daily; No-20, pumping 25 bbl. daily; and N-29, pumping 35 bbl. daily.

Dual completion stretches Texas Gulf Coast field

A prolific dually completed gas-condensate well is extending productive limits of Southwest Pheasant field, in Matagorda County, Texas Gulf Coast, more than ½ mile southwest.

The new producer, drilled by Socony Mobil Oil Co., Inc., has a combined potential of 176 M.M.c.f.d. of

gas. Of this, 118 M.M.c.f.d. is credited to the well's lower zone, perforated at 10,753-10,833 ft., and 58 M.M.c.f. to the upper pay at 10,536-74 ft. Both zones are in the Frio section.

The well, 1 George Harrison, was drilled to total depth of 11,185 ft. Location is 5 miles northwest of Palacios.

Flow from the lower zone was with a gas-liquid ratio of 20 M.c.f. of gas per barrel. Liquid is a 49.4°-gravity condensate. Shut-in pressure is 6,430 psi. Gas ratio of the upper zone was 15,780 cu. ft. per barrel. Gravity of the liquid is 50.7°. Shut-in pressure is 8,029 ft.

Discovery Wells

ARKANSAS

Bradley County:

Olin Oil & Gas Corp. 1 Brunson, 2-17s-12w. IP 72 BOPD, 16°, GOR 333 cu. ft. per bbl., perf. 3,381½-90½ ft., Cotton Valley. TD 5,093 ft. Discovery well Caseyville Landing field—3¼ miles southeast of Moro Bay.

Union County:

Schuler Drilling Co., Inc., and G. P. Brown et al. 1 Foster, SW SW NE 18-16s-16w, 3½ miles southwest of Smackover. IPP 15 BOPD, 20°, perf. 2,635½-37½ ft., lower Blossom sand. TD 2,649 ft. Extends Camp Creek field 1¼ miles northeast.

CALIFORNIA

Colusa County:

Western Gulf Oil Co. 1 Goff-Erdman, NE SW SW 15-13n-1e. Flowed at rate of 5 M.M.c.f.d. on drill-stem test at 7,503-46 ft. through ¼-in. choke, running drill-stem test at 7,793-7,851 ft., TD 7,851 ft. (New field discovery 3½ miles east of Buckeye gas field, which was discovered in January by Gulf.)

Universal Consolidated Oil Co. 1 Rheem-Hammer, 5-17n-1w. Gas reported during test at interval at 2,315-38 ft., TD 3,490 ft. (Discovery approximately 7,000 ft. northeast of Comption Landing gas production.)

Santa Barbara County:

Phillips Petroleum Co. et al. 5 State 2205, 2-4n-30w, drilled from an onshore location and bottom offshore in Parcel A lease, TD 8,871 ft. New offshore discovery and first completion after series of core holes drilled on 3,840-acre lease.

Sutter County:

Cameron Oil Co. and Franco Western Oil Co. 1 H. L. Sanborn & Sons, NE NE 32-15n-1e. Flowed at rate of 4 M.M.c.f.d. during 4-hour test of upper zone at 5,492-5,520 ft. and 5,700 M.c.f.d. during 3½-hour test of lower zone at about 7,000 ft., TD 8,102 ft. (New pool discovery in Grimes field. Approximately 8,000 ft. northeast of 1 Helen McLaughlin deeper pool discovery.)

COLORADO

Adams County:

Delhi-Taylor Oil Corp. 1 State-Plains, NE NE 16-2s-60w. IPF 1,900 M.c.f.d., 5/64-in. choke. "J" sand discovery at 6,432-44 ft. TD 6,505 ft. New gas field.

NORTH LOUISIANA

LaSalle Parish:

Justiss-Mears Oil Co., Inc., 1 James Greer, C SE NW 10-8n-2e, 2 miles southwest of Searcy. IPP 34 BOPD (net), 10% b.s. and w., 36°, perf. 2,692-94 ft., Wilcox-Greer sand. TD 3,757 ft. Discovery well of Searcy field.

NEW MEXICO

Lea County:

Thomas C. Brown 1 Federal, 12 miles southwest of Monument in 4-20s-35e. IPF 84 BOPD, 20/64-in. choke, 35°, TP 125 psi., CP 335 psi. Queen sand 4,954-68 ft. TD 5,024 ft. PBTD 4,982 ft. New oil discovery.

San Juan County:

El Paso Natural Gas Co. 5 Filan, SW SW 5-27n-8w. IPF Dakota 3,536 M.c.f.d., ¾-in. choke, SITP 2,166 psi.; IPF Mesaverde 1,433 M.c.f.d., ¾-in. choke, SITP 964 psi. Mesavrede 4,710-4,844 ft.; Dakota 6,858-98 ft. TD 7,035 ft. Dakota discovery, new field.

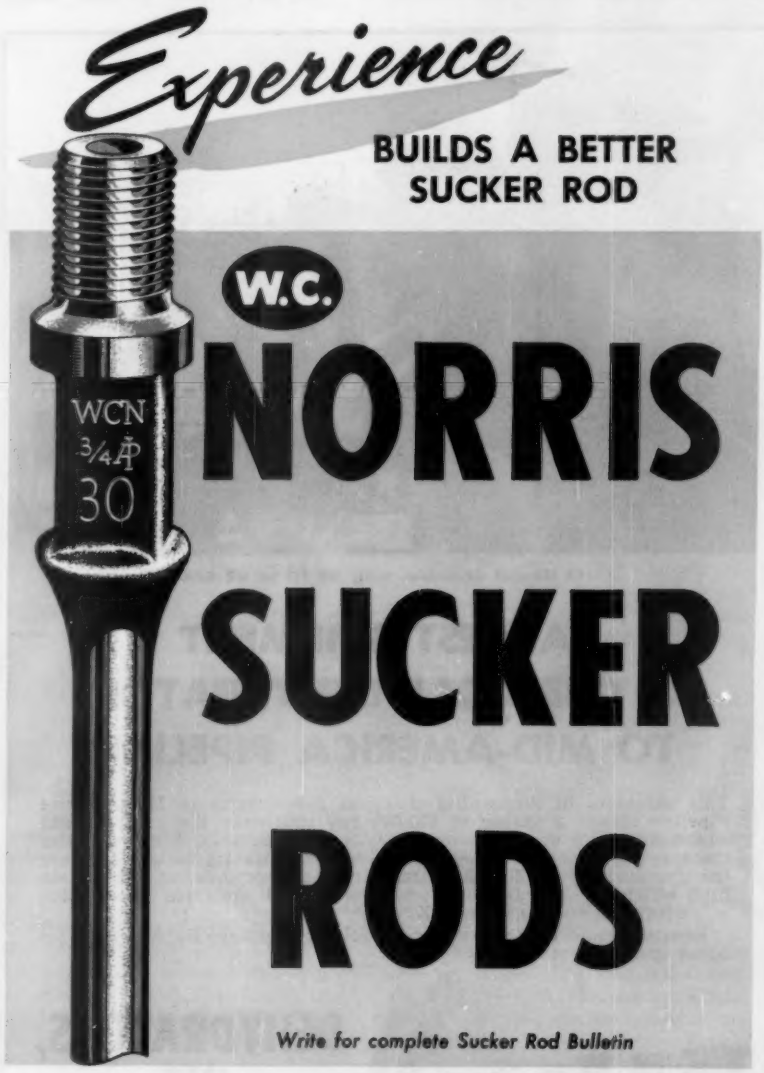
EAST TEXAS

Cass County:

Sunray Mid-Continent Oil Co. 1 Grogan Minerals Co., E. Vickers Sur., A-1062, 3 miles southwest of Bivins. IP 90 BOPD and 10 BWPD, ¼-in., 47°, GOR 1,914 cu. ft. per bbl., TP 50 psi., perf. 10,327-44 ft., Cotton Valley. TD 11,300 ft. Discovery well of Bivins field.

Rusk County:

Trice Production Co. and John C. Robbins, Jr., 1 Mollie Cagle, John Graham Sur., A-339, 3 miles southwest of Henderson. IP 87 BOPD, ¼-in., 41°, GOR 580 cu. ft. per bbl., TP 750 psi., perf. 7,438-61 ft. and 7,473-76 ft., Pettet.



TD 7,693 ft. Extends Pone field 1 mile west.

Titus County:

R. E. Moore and W. M. Coats 6 Hoffman et al., BBB&C Sur., A-74, 7 miles east of Talco. IPP 240 BOPD, 23°, GOR 200 cu. ft. per bbl., perf. 3,412-30 ft., Woodbine. TD 4,163 ft. Extends Trix-Liz field 3,000 ft. north.

NORTH TEXAS

Wise County:

Christie, Mitchell & Mitchell 1 Collins, 4 miles southeast of Alvord in Sec. 27, Grayson CSL, A-329. IPP 96 BOPD, plus 9% water, 42°, GOR 271:1. Bryson 2,894-95, 2,896-2,901 ft. TD 3,358 ft. New oil discovery.

TEXAS GULF COAST

Bee County:

Hugo Allen and M. J. Mitchell 1 William H. Welkener, Section 34, Plummer Subd., Lott Lands, Francis Chessman Sur., 5 miles northwest of Mineral. AOF 4,100 M.c.f.d., dry gas, 953 psi., perf. 2,964-68 ft., Pettus. TD 3,510 ft. Extension and new reservoir-discovery in Plummer area.

Hugo Allen and M. J. Mitchell 1 A. J. Smith, J. R. Johnson Sur., A-206, 6 miles northwest of Mineral. AOF 7,400 M.c.f.d., dry gas, 725 psi., perf. 1,807-11 ft. TD 2,020 ft. New pay in Plummer field.

DeWitt County:

Lion Oil Co. Division of Monsanto Chemical Co. and Commonwealth Oil Co. 1 Parqmann, Antonio Lazo Sur., A-653, 6 miles south of Nordheim. AOF 4,500 M.c.f.d, GLR 40,080 cu. ft. per bbl., 60.9°, shut-in TP 2,576 psi., perf. 7,746-51 ft., upper Wilcox. TD 12,015 ft. New pay in Pena field.

Kirkwood Drilling Co. and Musselman & Grace 1 Bridgen Oil unit, Charles Lockhart Sur., A-26, 4 miles west of Thomaston. AOF 4,800 M.c.f.d., GLR 133.5 M.c.f. per bbl., 56.7°, shut-in TP 2,520 psi., perf. 7,812-26 ft., Wilcox. TD 8,435 ft. Extension and new-reservoir discovery in Thomaston area.

Jefferson County:

Oil & Gas Property Management, Inc., 1 H. C. Phelan, Lot 11, W. C. Tyrrell Subd., S. Stivers Sur., A-51, 3 miles southeast of Amelia. IP 2,100 M.c.f.d., 12/64-in., TP 2,537 psi., perf. 7,727-28 ft., Frio; and 135.14 BOPD, 10/64-in., 29.5°, GOR 1,354 cu. ft. per bbl., TP 545 psi., perf. 6,284-94 ft., Frio. TD 8,678 ft. Discovery well of South Amelia field.

Live Oak County:

Skinner Corp. 2 Cartwright, F. Dietrich Sur., A-167, 7 miles south of Dinero. AOF 1,200 M.c.f.d., GLR 25.6 M.c.f. per bbl., 60°, 3,020 psi., perf. 6,226-31 ft., Yegua. TD 6,503 ft. Extension and new-reservoir discovery in Lagarto area.

Madison County:

Pure Oil Co. 1 Lummie Morgan, Antonio Del Rios Sur., 4½ miles southwest of Madisonville. IP 247.97 BOPD, ¼-in., 31.3°, GOR 2,650 cu. ft. per bbl., TP 950 psi., perf. 9,322-26 ft., Woodbine. TD 9,652 ft. Discovery well of Northeast Madisonville field—1 mile west of depleted Iron Creek field.

WEST CENTRAL TEXAS

Taylor County:

Sojourner Drilling Corp. 1-B E. Hankins, 4½ miles southwest of View in Goliad, CSL Sur. 143. IPF 80 BO in 7 hours, 24/64-in. choke, 40°, GOR 185:1, packer, TP 170 psi. Cook sand 2,969-74 ft. TD 5,485 ft. New oil discovery.

WEST TEXAS

Coke County:

Sojourner Drilling Corp. 1 J. R. Smith, 1 mile northwest of Wendkirk field and 5 miles southwest of Bronte in J. M. Davidge Sur. 967. IPP 83 BOPD, plus 25% water, 40°, GOR 150:1. Cisco open hole, top pay 3,715 ft. TD 3,723 ft. New oil discovery.

North Wendkirk field, 3,700 ft. Cisco sand. Sojourner Drilling Corp. 1 J. R. Smith, 5 miles southwest of Bronte in J. M. Davidge Sur. 967½. IPP 83 BOPD plus 25% water, 40°, GOR: 150:1. Cisco open hole. TD 3,723 ft. New oil discovery.

Fisher County:

G. E. Kadane & Sons 1 H. C. Beaver, 1¾ miles south of Claytonville multi-pay area, 2 miles northeast of Bernecker in Sec. 50, T&P Sur. IPF 219 BOPD, 16/64-in. choke, 41°, GOR 300:1, TP 45 psi., CP 100 psi. Caddo lime hole. TD 6,802 ft. New oil discovery.

Pecos County:

Trice Producing Co. 1 Frank A. Perry, 10 miles southwest of Iraan in Sec. 5, Blk. Z, TCRR Sur. Gas discovery in Northwest Sheffield field. IPCAOF 9,500 M.c.f.d., 6,974-84 ft. Pennsylvanian. TD 9,652 ft. New gas discovery.

Runnels County:

Anderson & Graham 1 Don Woodruff, 6 miles northwest of Ballinger in Sec. 167, ETRR Sur. IPP 52 BOPD plus 46% water, 46°, 2,538-42 ft. TD 2,542 ft. New oil discovery.

18 chemical dehydration units, 500 PSI at 500 GPM

LARGEST SHIPMENT OF CHEMICAL DEHYDRATORS TO MID-AMERICA PIPELINE

This shipment of dissipating chemical dehydrators to Mid-America Pipeline means a **saving of $12,000 per unit** over the cost of solid adsorbent units of the same capacity. Dehydrators, Inc. can offer these savings because of the exclusive compensating cartridge where the chemical compound is kept under constant compression to maintain high efficiency dehydration. Replacement cartridges are inexpensive . . . operation costs are low. **.009¢ per Gallon.**

Removes molecular size water particles in light crudes, kerosene, jet fuels, gasolines and LPGs.

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Tulsa, Oklahoma

Fast-Moving Pipeliner

. . . is Mid-America's Bob Thomas, a former railroader who built the biggest common carrier without oil-company help.

AN ABILITY to move fast put railroader Robert E. Thomas into the pipeline business while some major oil companies were sitting in the waiting room.

The new Mid-America Pipeline Co., is building an LPG line from New Mexico to the Twin Cities (see page 123)—one of the few pipelines (and undoubtedly the largest) conceived as a true common carrier and built without financial assistance from any oil company.

Thomas, president of Mid-America, got the idea for the project when he was chairman of the executive committee of the Missouri-Kansas-Texas Railroad Co.

A railroader in the pipeline business is quite a switch from the old days when railroads fought pipelines tooth and nail. Today several railroads have bowed to the inevitable and are getting their feet wet in the pipeline business with the philosophy "if you can't lick 'em, join 'em."

But Thomas' philosophy goes further. Instead of joining anybody, he licked them all by himself.

Thomas made his own timetable. He set an "impossible" schedule for financing and building the line and—to the astonishment of almost everybody—he met it.

Go-getter . . . Setting a fast schedule and meeting it has been a lifetime hobby with Thomas.

He was born near Akron, Ohio, 46 years ago and was ready for college during the Depression. Things were tough all over, but he announced that he was going to work his way through Wharton School of Finance in 3 years. He did.

When he got his BS in economics in 1936 he announced he was going to be earning $12,000 a year by the time he was 30.

His first job was with an investment trust. Thomas started at $200 a month, and he hit the $12,000 figure in 4 years.

Joins Katy . . . Later, Thomas was the specialist on railroad investments and in 1953, he became vice president of Madison Fund, Inc. In 1955 he was made a director and chairman of the finance committee of the M-K-T Railroad.

A year later he was chairman of the executive committee, and he and the Katy's dynamic young president, William N. Deramus III, got busy pulling the road out of the red and putting it on its feet.

There's a lot of truth in the popular criticisms of railroad management, Thomas says. He thinks many rail executives are complacent, unreceptive to new ideas, hidebound by tradition, tied up in their own bureaucratic red tape, too slow-moving, and spend too much time making and reading reports.

The oil industry as a whole isn't subject to the same criticism, in Thomas's opinion. Thomas showed that at least one Wall Street-and-railroad man could move mighty fast when he decided to get into the oil business.

Pipeline idea . . . Exactly 3 years ago Thomas got the idea that the Katy could make more money hauling LPG in a pipeline than in tank cars. His first thought was to follow the right-of-way of Katy and another railroad with a pipeline into the Ohio region. This fell through for a variety of reasons, but by that time Thomas was convinced of the possibilities and started over on a fresh approach.

He quietly made his plans and then "pushed the button," as he says, December 1, 1959, starting a schedule which called for delivering LPG to St. Paul within exactly 1 year. Things had to move with railroad precision, and they did.

He got no definite commitments of traffic, but many small and large producers and distributors of LPG gave letters of intent to use the line if built.

With these, plus market studies, he persuaded friends in Wall Street to underwrite the financing. He got that assurance one morning, and that afternoon the mill started rolling the pipe and land men were out getting right-of-way.

Highballer . . . Several big potential shippers gave him no encouragement at all, and a couple tried to upset his apple cart. It was just unheard-of for an "outsider" to horn into the pipeline business or to build a petroleum line with no shipper-owners. But Thomas knew that if he hesitated one or more oil companies would grab the ball and build the line, so he highballed straight ahead.

Today as he sits in his Tulsa office checking reports on the line's construction progress, Thomas has a little time to speculate on the future of the oil business of which he is now a part.

But Thomas is a man of action, not speculation. Witness his new proposal to build a condensate line from Superior, Wis., to Chicago.

He isn't saying whether he has further plans in pipelining. But his habit of moving fast suggests that the rest of the pipeline industry would do well to keep an eye on this newcomer.

Personals

Ralph J. Schilthuis, executive vice president and member of the board of management of Humble Oil & Refining Co.'s Humble division, has been named vice president for production in Humble's headquarters organization. He will be responsible for coordination of all Humble production activities. Schilthuis was honored last week as recipient of AIME's 1960 John Franklin Carll award, which recognizes outstanding achievements in petroleum-engineering. He has been with Humble since 1930 and was vice president and a director of the old Humble company before its reorganization last year. He became executive vice president of the Humble division at that time.

James L. Morris, division manager for Pure Oil Co., has been transferred to Houston from Fort Worth in a consolidation of the two divisions.

J. E. Carothers, Phillips Petroleum Co., Bartlesville, Okla., has been elected president of the Tulsa chapter, Society of Well Log Analysts. Other new officers are **Robert Sarmiento,** Jersey Production Research Co., Tulsa, vice president; and **William Lang,** Cities Service Oil Co., Bartlesville, secretary-treasurer.

G. E. Stevens, Casper, Wyo., has been elected vice president of Signal Drilling & Exploration, Inc. He will continue as drilling superintendent of the company. Stevens was elected during Signal's recent annual meeting in Denver. All other officers and directors were reelected.

Laurence C. Bergquist, a vice president of Iricon Agency, Ltd., London, has been named executive vice president and general manager of the company. He succeeds **Arthur H. Elliot,** who is retiring but will continue as a consultant to Iricon. Bergquist will represent Iricon's principals on the boards of Iranian Oil Participants, Ltd., and Iranian Oil Services, Ltd. Iricon Agency represents eight American companies in Iranian consortium operations.

Dr. Walter H. Granata, Jr., formerly with Sohio Petroleum Co. in Houston, has joined the production and exploration department of Monsanto Chemical Co.'s Lion Oil Co. division in Shreveport, La.

Frank V. Williams, manager of Standard-Vacuum Oil Co.'s lubricating and special-products supply department in White Plains, N. Y., has been transferred to Standard-Vacuum Refining Co. of South Africa (Pty.), Ltd., as manager of the Durban, South Africa, refinery.

A. W. Bally has been named senior geologist in charge of Shell Oil Co. of Canada's stratigraphic and special-studies sections in Calgary. He succeeds **Peter Fitzgerald-Moore,** who has been transferred to headquarters of the Royal Dutch-Shell group in The Hague.

R. W. Hall, manager of the technical services division, research and technical department, for Texaco Inc. in Beacon, N. Y., has been transferred to Houston as manager of Texaco's new research and technical department managerial office there. **R. F. Nelson,** director of the Port Arthur, Tex., technical services group, and **C. L. Crawley,** research associate in Port Arthur, have been assigned to the new managerial office as assistants to the manager.

Raymond T. Kern, Jr., has been transferred from Gulf Oil Corp.'s refinery-technology laboratory in Philadelphia to Gulf Research & Development Co. in Harmarville, Pa., where he will be staff product-application engineer in the marketing and technical-service division. **Raymond P. Nejak** and **Robert C. Amero** have also been named staff product-application engineers in marketing technical service. Nejak had been in the physical-science division, Harmarville, and Amero had been in the product division.

Headquarters for Gulf Oil Corp.'s domestic transportation system have been moved to Houston from Pittsburgh. **J. L. Irvin,** president of Gulf Refining Co. and manager of Gulf pipelines, will take on additional responsibility for the domestic traffic department. This department plans oil movement by common carrier and inland barge. **Walter L. Shannon,** director of pipeline engineering for Gulf in Pittsburgh, has been transferred to Houston as manager of domestic pipelines. **William M. Johnson,** has moved from Pittsburgh to Houston as general traffic manager in Irvin's department. **Arthur Ernst,** manager of barge transportation, has also moved to Houston from Pittsburgh.

J. S. Burden, a vice president of O. R. Burden Construction Corp., has been elected president. He succeeds the late O. R. Burden, founder of the firm. **P. T. Thibodaux,** vice president, has been elected executive vice president and **Paul E. Thibodaux,** estimator, has been elected a vice president. **William G. Eastman,** vice president and secretary; **G. S. Downey,** vice president; and **E. O. Yelton,** treasurer and assistant secretary; continue in these positions.

E. Clyde McGraw, president of Transcontinental Gas Pipe Line Corp., will serve as president of Transco's new subsidiary, Trans - Southern Pipeline Corp. Trans - Southern plans to build an LPG pipeline from Texas to Virginia (OGJ, Oct. 3, p. 66). **Robert L. Topper,** executive assistant to McGraw, will be executive vice president of the new firm. Topper is president of Trans-Jeff Chemical Corp., another Transco subsidiary. Other Transco officials will serve in the following capacities with Trans-Southern: **John F. Burton,** vice president; **William H. Davidson, Jr.,** vice president and general counsel; **James B. Henderson,** vice president; **Dan Williamson,** vice president, land; **A. E. Bryan,** treasurer; and **Tom H. Wheat,** secretary. Construction is scheduled to begin on Trans-Southern's line next spring with completion expected by fall.

McGRAW

H. J. Grady, formerly president of California Spray Chemical-Corp., has been named president of the Ortho division of California Chemical Co. **T. G. Hughes,** president of Oronite Chemical Co., has been named president of California Chemical's Oronite division. These changes consolidate all chemical activities of Standard Oil Co. of California in one subsidiary, the new Cal Chemical. **Fred Powell,** formerly vice president of manufacturing for California Standard's Western Operations, Inc., was named president of Cal Chemical several months ago. Other officers in the new company are **W. H. Shiffler,** vice president and manager of planning and development, and **J. Q. Cope,** vice president and manager of facilities and negotiations.

▶▶▶ Personals

Marvin Lester, tool pusher with International Drilling Co. in Kuwait, has retired and moved to Georgetown, Tex.

William B. Agocs, formerly with Aero Service Corp., has opened petroleum and mineral exploration consulting offices in Philadelphia.

W. M. Metrailer has been named a research associate at Humble Oil & Refining Co.'s Esso Research Laboratories, Baton Rouge, La.

Stanley B. Mirviss and **Samuel B. Robison** have been named research associates in Esso Research & Engineering Co.'s chemicals-research division.

Edson D. Blossom, field superintendent for Signal Oil & Gas Co., has been named superintendent of the company's Fox, Okla., natural-gasoline plant.

John F. Holohan, Jr., and **D'Arcy C. Randall** have joined the staff of the Whiting, Ind., research laboratories of Standard Oil Co. (Ind.). Holohan will work with pilot-plant studies of new petrochemical processes, and Randall with new applications for electronic computers.

Harrison B. Haney, Tidewater Oil Co.'s vice president of transportation, has retired after 43 years with the company. Haney had served as superintendent of construction and chief engineer in San Francisco before being named western division manager of transportation in 1936. He became a vice president in 1949 and vice president, transportation, in 1956.

Grove Lawrence, vice president of Pacific Lighting Gas Supply Co., has been elected president of Pacific Natural Gas Exploration Co., newly organized gas-exploration and development subsidiary of Pacific Lighting Corp. **Stuart T. Peeler,** of Musick, Peeler, & Garrett, Los Angeles law firm, has been elected vice president and secretary of the new company, and **Harry L. Bosshard,** staff assistant with Southern California Gas Co., has been named treasurer and assistant secretary. Directors will be Lawrence, Bosshard, and **Joseph D. Peeler,** Musick, Peeler, & Garrett. **Thomas A. Johnson, Jr.,** gas-reserves engineer with Pacific Lighting Gas Supply, has been named field manager. Lawrence had been superintendent of production and transmission, general superintendent of gas manufacture, compression, and storage, and a vice president of Southern California Gas Co. before moving to Pacific Lighting Gas Supply in 1958. He will continue as a vice president of this company. Pacific Natural Gas Exploration, a wholly owned subsidiary of Pacific Gas Lighting Corp., will undertake joint exploration ventures with Southern Union Gas Co.

LAWRENCE

Joseph L. Fiegener, senior petroleum engineer for Sinclair Oil & Gas Co., has been transferred to Tulsa from Drumright, Okla. **William A. DeShazer,** junior petroleum engineer in Tulsa, has been transferred to Drumright.

E. A. Williford, assistant general manager of Continental Oil Co.'s marketing department in Houston, has been named vice president of Kayo Oil Co., Conoco subsidiary, in Chattanooga, Tenn. Conoco bought Kayo last year.

William C. Dougherty, production superintendent for the Midland, Tex., division of United States Smelting, Refining & Mining Co., has been named production manager of the company's oil department. **Harvey M. Head,** Midland division land man, has been named oil department land manager.

Jack Morris, Denver district exploration superintendent for Tennessee Gas & Oil Co., has been transferred to Casper, Wyo., in the same capacity. **R. C. Blakely,** district geologist has been transferred to Shreveport, La., from Denver. **George Anderson** has been transferred from Denver to Casper as district geophysicist, and **Dick Powers,** Denver geologist, also has been moved to Casper.

Four new directors have been named to the board of Canadian Husky Oil, Ltd. making the boards of Canadian Husky and its subsidiary, Husky Oil Co., identical. The new directors are **W. Turner Clack,** chairman of Husky Oil's subsidiary, Husky Hi-Power, Inc.; **John L. Kalb,** Phoenix petroleum consultant; **Hugh H. Millar,** president of Western Construction & Lumber Co., Ltd., Edmonton; and **H. R. Milner,** partner in Milner, Steer, Dyde, Massie, Layton, Cregan, & Macdonnell, Edmonton law firm. They succeed **Geo. S. Buchanan,** and **Lawrence W. Lee,** both Husky officers, **Kenneth M. Johnston** and **Paul J. Guthrie** on the Canadian Husky board.

J. S. Royds, administrative vice president and general manager of Continental Oil Co.'s domestic exploration department, has been appointed vice president and exploration manager for the company's foreign exploration and production department, a new position. He will headquarter in New York. **W. O. Ham, Jr.,** general manager of Conoco's southwestern region in Fort Worth, will succeed Royds as general manager of the domestic exploration department in Houston. **Harold R. Prescott,** assistant general manager of the foreign exploration and production department, has been promoted to assistant manager of the domestic exploration department, a new post. He will continue to headquarter in Houston. Royds is a former exploration manager for Sahara Petroleum Co., an affiliate, in Egypt. He was assistant manager of the foreign exploration and production department before his domestic exploration appointment in 1957. Ham had been director of organization and planning and coordinator of reserves purchases in Houston before the Fort Worth assignment.

ROYDS

HAM

Norman R. Callaway, supply and analysis coordinator in the crude-oil purchasing section of Imperial Oil Ltd., has been appointed manager of Imperial's crude-oil purchasing office in Calgary. He succeeds **M. J. (Jack) Huffman,** who has been named management assistant in the transportation and supply department, Toronto.

Bruce K. Brown, New Orleans consultant, and **Myron R. Holmgren,** a vice president of Murphy Corp., have been elected directors of Murphy. Brown is former president and chairman of Petroleum Chemicals, Inc. He also served as vice president in charge of development and a director of Standard Oil Co. (Ind.) and president of the old Pan-Am Southern Corp. Holmgren is president of River States Oil Co., Murphy marketing subsidiary. He was named a Murphy vice president last year.

Personals

John P. Hammond, executive assistant for Amerada Petroleum Corp., and **Robert J. Stanton,** general counsel, have been elected vice presidents. Hammond has been with Amerada

HAMMOND

STANTON

since 1941. He was assistant to the vice president in charge of production and assistant general superintendent of production before being appointed executive assistant last year. In 1957 he served as first president of AIME's Society of Petroleum Engineers. Stanton was with Martin, Logan, Finney, Stanton & Moyers, Tulsa law firm, before joining Amerada in 1954 as general counsel.

George W. Velota and **C. M. Kilgore,** geologists with Sohio Petroleum Co., have been transferred to Amarillo, Tex., from Oklahoma City.

Earl M. Kipp, San Francisco, special consultant on producing problems with Standard Oil Co. (Calif.), has been elected 1961 president of AIME's Society of Petroleum Engineers. He will take office in February succeeding **Wayne E. Glenn,** production manager for Continental Oil Co. New vice presidents of the society are **Milton E. Loy,** Schlumberger Well Surveying Corp., New Orleans; and **L. P. Whorton,** Atlantic Refining Co., Dallas. Officers were named at the society's annual meeting last week in Denver.

M. L. Vance, Advance Drilling Co., Mount Vernon, Ind., has been named chairman of the Tri-State chapter, American Association of Oilwell Drilling Contractors. Other new officers are **Fred R. Pattillo,** T & H Corp., Terre Haute, Ind., vice chairman; and **Elmer L. Hoehn,** Evansville, Ind., secretary-treasurer; Directors are **Hunter Eakle,** Eakle & Holder Drilling Co., Evansville; **Henry Gwaltney,** Gwaltney Drilling, Inc., Washington, Ind.; **John Burns,** Burns Drilling Co., Evansville; and **C. E. Winn,** C. R. Winn Drilling Contractor, Salem, Ill. The new officers will be installed January 1.

Stewart A. Hoge, geologist with Sinclair Oil & Gas Co., has been transferred to Ardmore, Okla., from Oklahoma City.

Oscar F. Yates, senior petroleum engineer for Humble Oil & Refining Co., has been transferred to Hawkins, Tex., from Tyler, Tex.

Roger F. Jones, formerly with Atlantic Refining Co., has joined Avi-Sun Corp. in Marcus Hook, Pa., as research chemist.

Dodd N. Osburn, district geologist for Union Producing Co. in New Orleans, has been transferred to Lafayette, La., in the same capacity.

H. G. Russell, manager of retail and jobber sales in Gulf Oil Corp.'s Toledo division, has been promoted to manager of the Toledo marketing division.

Robert L. Brace, production engineer with Continental Oil Co. in Oklahoma City, has been promoted to district engineer and transferred to Ardmore, Okla.

William D. Harris has been named manager of Lion-brand sales for Monsanto Chemical Co.'s Lion Oil Co. division. He succeeds **Frank Graves,** who recently was named manager of private-brand sales. **Roy W. Spence,** senior sales representative for Lion in Mississippi, Tennessee, and eastern Arkansas, has retired after 21 years with the company.

A. F. Hamilton, formerly assistant vice president of Renwar Oil Corp., has been elected vice president and general manager of Texas Gas Exploration Foreign, C.A., foreign operations subsidiary of Texas Gas Exploration Corp., Houston. Hamilton has set up offices in Calgary and will work with extension of the company's operations in Canada.

Martin L. Kaplan has joined Richfield Oil Corp.'s Anaheim, Calif., research center as research chemist.

Blake B. Schiff has been named senior economics engineer for Signal Oil & Gas Co. in Los Angeles. Schiff was with Eastern States Petroleum & Chemical Corp. in Houston before its merger with Signal. He moved to Los Angeles with Signal several months ago.

Morris B. Taubman, president of Buffalo Petroleum Corp., has been named chief executive officer succeeding the late H. P. Taubman, who was chairman and chief executive officer. The office of chairman will be left vacant. Morris Taubman will move to Buffalo's Tulsa headquarters from Fort Worth. **Robert Taubman,** vice president and manager of the Midland, Tex., area, has been elected a director of the company. **Louis Taubman** will continue as executive vice president.

Deaths

John A. Ritter, 73, retired general operating superintendent of Sun Oil Co.'s southwest division, Dallas, died October 1 after a long illness. Ritter joined Sun in 1923 as assistant to the division production superintendent. He retired in 1954. Ritter was active in the American Petroleum Institute, serving as chairman of the southwestern district, Division of Production and as chairman of the API committee on vocational training.

W. L. (Bill) Geitzentanner, 41, Big Chief Drilling Co.'s manager of operations for the Madrejones concession held by Big Chief and Bolivian Oil Co. in La Paz, Bolivia, died of a cerebral hemorrhage recently while on a business trip to Buenos Aires. Geitzentanner was with Continental Oil Co. before joining Big Chief in 1954 as a production engineer.

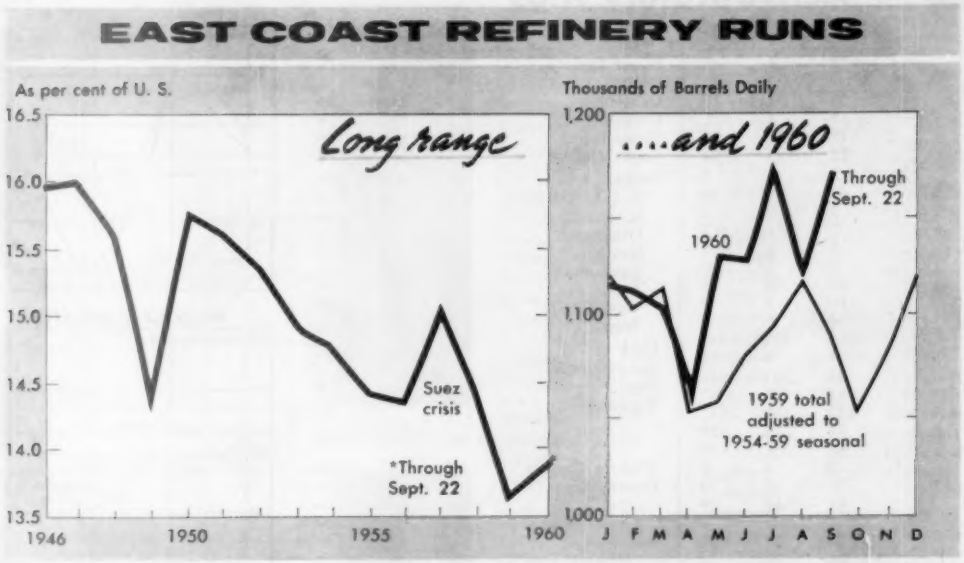
Sylvester Davis, 56, retired chief dispatcher for Gulf Oil Corp. crude-oil movement in the United States and Canada, died October 2 in a Houston hospital. Davis was with Gulf 30 years before he retired in 1958.

William M. Cocke, vice president and general manager of Cit-Con Oil Corp., died recently in Lake Charles, La., after a brief illness.

Odis Hurt, 45, Crossville, Ill., independent operator, died September 24 of burns received in an oil-well fire.

Gayle M. Pickens, 52, attorney for Skelly Oil Co., died September 30 in a Tulsa hospital.

A. Z. Phillips, 49, Shawnee, Okla., independent operator, died September 30 in a Shawnee hospital.



A DEFINITE DOWNWARD TREND developed in the East Coast portion of total refinery runs after World War II. Activity reports since April indicate an upturn.

RUNS FOR May, June, and July show an average gain of about 6% over adjusted runs for same months last year.

East Coast refiners reverse trend

BY JOHN C. CASPER

EAST COAST REFINERS picked a bad time to catch up on refinery runs. They have been gradually dropping behind in the postwar scramble to turn out more refined products for an expanding market.

But, product markets are walking a tightrope this fall. The difference between reasonably firm product prices and cutthroat competition may be the extra millions of barrels of crude pushed through Gulf Coast and East Coast refineries.

First, take a look at the growth pattern for East Coast refineries since the end of World War II. Comparisons are shown in the first chart. The line on the chart measures East Coast growth in terms of its percentage of the national total.

For the years 1946 and 1947, refinery runs on the East Coast accounted for about 16% of total runs in the country. The district's share of the total has been under 14% for the past 2 years.

Note the sharp dip in the recession year 1949 and recovery in 1950. This dip was followed by an unbroken series of losses in the 6-year period from 1950 through 1956. The gain in 1957 was due to high product demands that developed during the Suez crisis.

The return to normal after Suez meant a return to the postwar decline pattern for East Coast refiners. Crude runs for 1959 represented only 13.66% of the national total.

The decline shown by the line is not an actual reduction in crude runs. It represents a slower rate of growth than the average for the country as a whole. Actual runs at East Coast refineries increased from 758,000 bbl. daily in 1946 to 1,194,000 bbl. daily for 1957. But, the East Coast portion of the total dropped from 15.99% in 1946 to 15.08% in 1957. East Coast runs so far this year have accounted for 13.88% of the U. S. total compared with 13.66% for all of 1959.

The second chart compares actual East Coast runs this year with total 1959 runs adjusted to the average 1954-59 seasonal. Note that activity followed a normal pattern through April. Since that time, runs have tended to be on the high side for every month except August.

The 6-year pattern of East Coast activity calls for decreases in runs for September and October. For the first 22 days of September, runs were up 4.5% over the August average. Marketers are waiting for some indication of operators' plans for October.

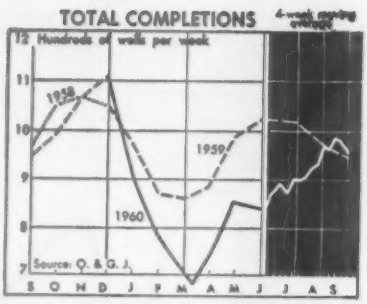
A quick look at the highlights . . .

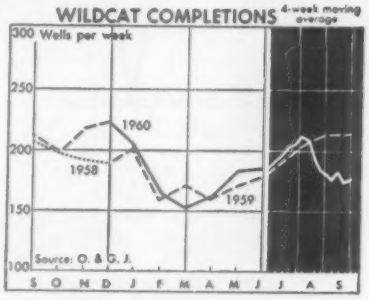
	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	6,866,820	DOWN	25,100	DOWN	2,546
Crude stocks	230,362,000	UP	419,000	DOWN	19,948,000
Completions	946	DOWN	16	UP	1
Refinery runs	7,949,000	DOWN	14,000	UP	331,000
Gasoline stocks	187,417,000	UP	511,000	UP	11,560,000
Kerosine stocks	35,151,000	UP	255,000	UP	2,920,000
Distillate stocks	168,625,000	UP	3,178,000	DOWN	5,544,000
Residual stocks	50,325,000	UP	1,981,000	DOWN	9,199,000
Four-product stocks	441,518,000	UP	5,925,000	DOWN	263,000
Total imports	1,742,000	UP	183,300	DOWN	218,900

Active Rotary Rigs

	10-3-60	9-26-60	10-5-59
Alabama	2	3	5
Alaska	7	7	(†)
Arkansas	10	11	19
Arizona	1	1	1
California	75	87	88
Land	72	84	84
Offshore	3	3	4
Colorado	49	52	60
Florida	3	2	2
Land	2	1	2
Offshore	1	1	0
Georgia	1	1	0
Illinois	47	40	35
Indiana	10	8	9
Iowa	1	1	1
Kansas	114	122	148
Kentucky	7	4	11
Louisiana	295	289	329
North	31	37	47
S. Inland waters	123	117	117
S. Land	81	76	110
Offshore	60	59	55
Maryland	0	0	0
Michigan	35	37	37
Mississippi	61	66	79
Missouri	1	1	0
Montana	24	25	31
Nebraska	21	23	24
Nevada	0	2	1
New Mexico	95	104	101
New York	2	2	0
North Dakota	14	16	20
Ohio	6	6	5
Oklahoma	168	155	214
Oregon	1	1	0
Pennsylvania	8	8	10
South Dakota	1	1	8
Texas	595	600	766
S. Inland waters	5	5	6
S. Land	157	156	188
Offshore	1	1	0
North	39	43	183
Panhandle	49	50	(*)
East	69	66	(*)
West Central	162	166	237
West	113	113	152
Utah	23	28	32
Washington	1	1	2
West Virginia	6	6	8
Wyoming	73	72	93
Total U. S.	1,757	1,782	2,139
Western Canada	147	143	174
Eastern Canada	0	0	1
Grand total	1,904	1,925	2,314

Hughes Tool Co. report. *Included in North. Comparisons not available due to change in method of reporting. †Data first reported 4-4-60.

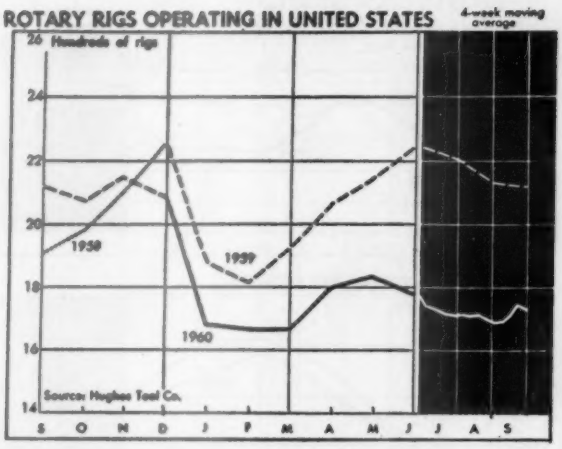




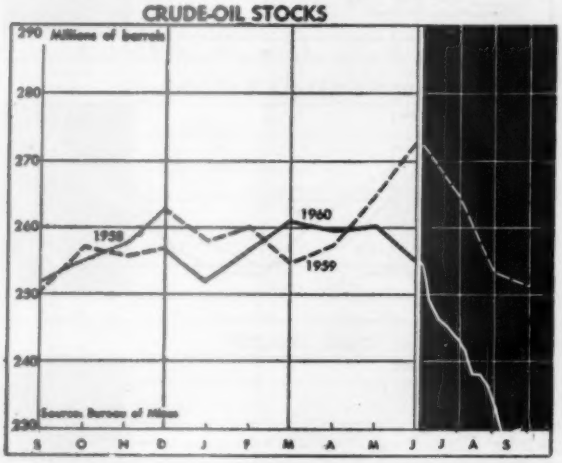
WEEKLY WELL COMPLETIONS . . . WEEK ENDED OCTOBER 1, 1960

	Total wells							Cum.		Total wildcats					Cum.	
	Total	Crude	Cond.	Gas	Dry	Service	Footage	1960	1959	Total	Crude	Cond.	Gas	Dry	1960	1959
Alabama	0	0	0	0	0	0	0	33	77	0	0	0	0	0	2	20
Arizona	0	0	0	0	0	0	0	28	.....	0	0	0	0	0	18	.....
Arkansas	9	4	0	0	5	0	26,845	445	632	4	2	0	0	2	120	112
California	42	28	0	3	11	0	154,388	1,226	1,140	10	1	0	1	8	234	301
Colorado	11	0	0	2	9	0	65,914	476	579	6	0	0	0	6	240	343
Illinois	60	20	0	1	22	17	112,347	1,706	1,713	15	3	0	0	12	358	287
Indiana	21	8	0	0	13	0	26,985	783	621	7	0	0	0	7	285	212
Kansas	187	63	0	7	101	16	306,882	2,899	3,006	27	4	0	6	17	787	755
Kentucky	19	3	0	2	14	0	29,276	1,550	1,836	8	1	0	0	7	135	211
Louisiana	64	26	5	4	28	1	504,960	2,656	2,827	10	0	0	0	10	407	378
North	26	8	0	4	14	0	124,104	999	1,084	4	0	0	0	4	195	167
South	30	11	5	0	13	1	302,805	1,283	1,433	6	0	0	0	6	187	197
Offshore	8	7	0	0	1	0	78,051	374	310	0	0	0	0	0	25	14
Michigan	19	6	0	0	10	3	66,292	691	472	10	0	0	0	10	185	120
Mississippi	11	4	0	0	7	0	107,566	515	482	3	0	0	0	3	197	214
Montana	4	1	0	0	3	0	23,995	237	242	2	0	0	0	2	111	78
Nebraska	13	4	0	0	9	0	60,483	650	690	6	2	0	0	4	266	297
New Mexico	54	20	1	17	15	1	226,209	1,405	1,570	8	3	0	0	5	211	182
West	29	6	1	15	6	1	116,751	489	709	4	1	0	0	3	58	49
East	25	14	0	2	9	0	109,458	916	861	4	2	0	0	2	153	133
New York	18	8	0	0	3	7	22,770	250	214	0	0	0	0	0	33	18
North Dakota	6	4	0	0	2	0	32,813	225	357	1	0	0	0	1	60	67
Ohio	14	7	0	3	3	1	39,431	799	752	0	0	0	0	0	38	23
Oklahoma	44	23	3	3	13	2	127,470	3,454	4,300	4	1	0	0	3	553	658
Pennsylvania	0	0	0	0	0	0	0	519	392	0	0	0	0	0	10	10
South Dakota	1	0	0	0	1	0	5,158	19	.....	1	0	0	0	1	8	.....
Texas	309	138	14	14	136	7	1,259,215	11,766	14,249	65	4	0	2	59	2,413	2,689
District 1	24	9	1	2	12	0	64,350	812	815	7	0	0	2	5	303	241
District 2	7	1	1	1	4	0	47,336	576	592	1	0	0	0	1	143	174
District 3	18	4	4	1	9	0	139,992	890	908	4	0	0	0	4	167	184
District 4	21	6	3	2	10	0	123,609	811	1,013	5	0	0	0	5	227	252
East	30	13	0	0	17	0	129,750	963	937	9	1	0	0	8	197	181
District 7-B	46	13	0	2	29	2	134,507	1,719	1,966	7	0	0	0	7	487	525
West	69	48	3	2	14	2	379,308	3,066	4,359	11	2	0	0	9	473	600
District 9	81	38	2	0	38	3	193,382	2,164	2,669	21	1	0	0	20	372	448
District 10	13	6	0	4	3	0	46,981	765	990	0	0	0	0	0	44	84
Utah	3	0	0	0	3	0	26,976	176	237	3	0	0	0	3	62	63
West Virginia	16	0	0	14	1	1	44,784	618	587	0	0	0	0	0	6	24
Wyoming	20	9	0	1	10	0	93,373	776	743	8	0	0	0	8	317	256
Misc. (Alaska)	1	0	0	0	1	0	9,034	114	113	1	0	0	0	1	104	76
Total U. S.	946	376	23	71	420	56	3,373,166	34,016	37,831	199	21	0	9	169	7,160	7,394
Prev. week	962	392	23	127	306	114	3,592,073	.....	.....	152	11	2	6	133	.....	.....
Cum. 1960	34,016	15,356	992	2,814	12,978	1,876	142,025,669	.....	.....	7,160	634	78	244	6,204	.....	.....
Cum. 1959	37,831	18,852	934	2,769	14,241	1,035	157,605,456	.....	.....	7,394	674	91	236	6,393	.....	.....
Western Canada	41	28	0	2	10	1	241,356	1,740	1,831	12	2	0	1	9	456	515

ROTARY RIGS OPERATING IN UNITED STATES



CRUDE-OIL STOCKS



CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	9-24-60	9-17-60	9-26-59
Pennsylvania	2,360	2,327	2,646
Other Appalachian	1,443	1,569	2,112
Illinois, Indiana, Michigan	8,857	9,160	9,752
Nebraska and North Dakota	2,885	2,795	2,818
Kansas	8,502	8,518	10,070
Oklahoma	15,345	14,916	14,456
Arkansas	1,845	1,837	2,264
Louisiana	17,815	17,386	17,507
North	3,019	3,069	3,375
South	14,796	14,317	14,132
Mississippi, Alabama, Florida	1,735	1,659	2,472
New Mexico	8,182	8,337	7,964
Texas	96,428	96,604	106,742
East Texas	7,366	7,661	8,281
West Texas	46,609	47,169	49,354
Texas Gulf	16,476	16,305	19,034
Other Texas	25,977	25,469	30,073
Wyoming	15,930	15,120	16,137
Other Rocky Mountain	9,161	9,285	9,272
California	26,585	25,962	29,651
Foreign	†13,289	14,468	16,447
Total	**230,362**	229,943	250,310

*Bureau of Mines. †Includes 4,414,000 bbl. in California.

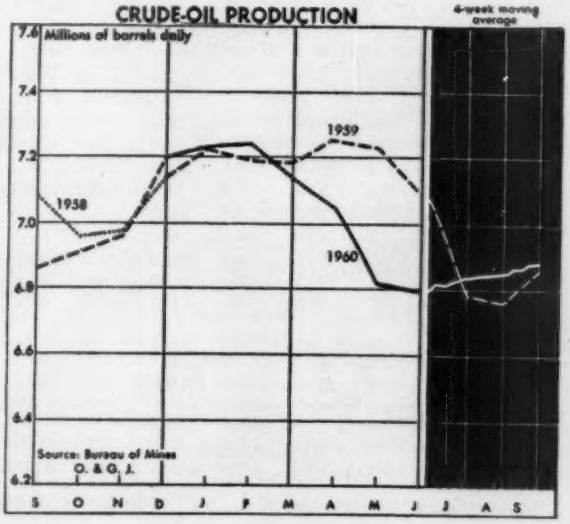
DAILY AVERAGE PRODUCTION FOR WEEK

	October 1, 1960 — Crude oil	Lease condensate	Total	Sept. 24 total
Alabama	21,500	.....	21,500	22,000
Arkansas	77,300	200	77,500	77,400
California	829,000	.....	829,000	828,800
Colorado	130,500	.....	130,500	131,700
Eastern	39,600	.....	39,600	39,800
Florida	900	.....	900	900
Illinois	220,700	.....	220,700	217,400
Indiana	31,900	.....	31,900	31,000
Kansas	†297,920	.....	†297,920	†304,895
Kentucky	60,000	.....	60,000	56,700
Louisiana	951,500	123,300	1,074,800	1,074,775
North	104,500	5,800	110,300	110,275
South	847,000	117,500	964,500	964,500
Michigan	42,000	.....	42,000	41,800
Mississippi	132,000	3,550	135,550	135,550
Montana	81,700	.....	81,700	82,000
Nebraska	68,000	.....	68,000	67,200
Nevada	100	.....	100	100
New Mexico	287,500	8,000	295,500	295,500
North Dakota	61,500	.....	61,500	62,300
Oklahoma	†473,700	.....	†473,700	†499,700
Texas	2,380,000	81,500	2,461,500	2,461,500
Dist. 1	42,000	2,500	44,500	44,500
Dist. 2	98,000	8,000	106,000	106,000
Dist. 3	306,000	36,000	342,000	342,000
Dist. 4	171,000	12,200	183,200	183,200
Dist. 5	26,000	300	26,300	26,300
Dist. 6	109,000	9,800	118,800	118,800
East Texas Field	124,000	.....	124,000	124,000
Dist. 7-B	129,000	125	129,125	129,125
Dist. 7-C	113,000	3,050	116,050	116,050
Dist. 8	960,000	7,000	967,000	967,000
Dist. 9	195,000	1,600	196,600	196,600
Dist. 10	107,000	925	107,925	107,925
Utah	94,300	.....	94,300	102,200
Wyoming	358,000	.....	358,000	357,100
Others	‡1,650	.....	‡1,650	‡1,600
Total U. S.	6,641,270	216,550	**6,857,820**	6,891,920
Change from previous week, down			**34,100**	
Canada	†525,700	.....	†525,700	†546,700

Total U. S. production—Jan. 1-Oct. 1 ..... 1,923,920,600 bbl.
Same period last year (crude plus cond.) ..... *1,934,824,000 bbl.

*Includes 51,175,900 bbl. condensate. †Week ended previous Monday. ‡Alaska, South Dakota, and Arizona.

CRUDE-OIL PRODUCTION



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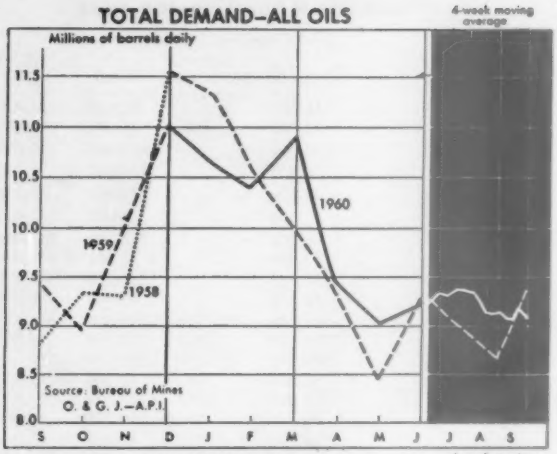
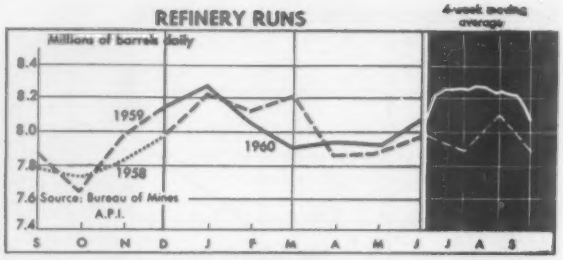
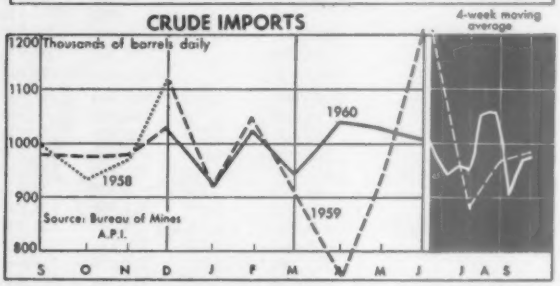
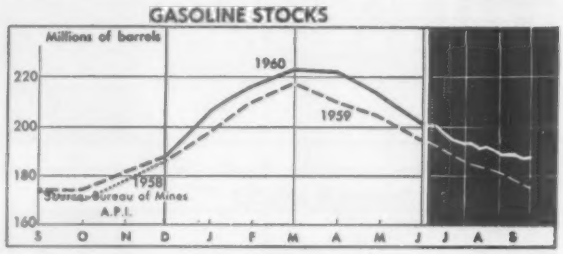
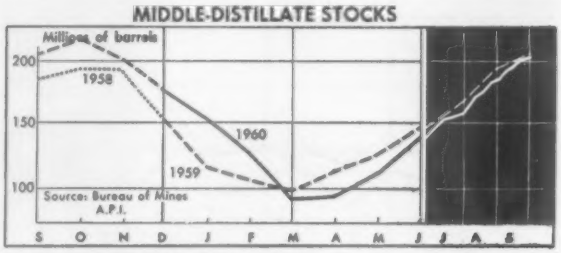
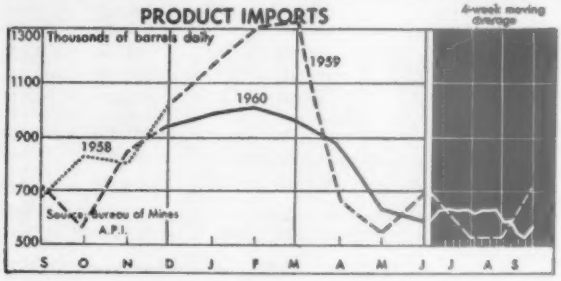


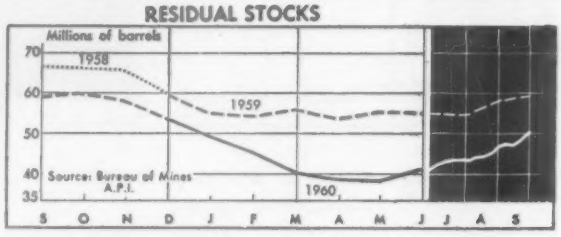












API REFINERY REPORT—SEPTEMBER 30, 1960

(Thousands of barrels)

District—	Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.	Stocks‡ Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, September, 1959 Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.
East Coast	1,139	525.6	27.3	389.5	162.7	43,398	13,767	63,257	13,249	1,065	520.0	30.8	321.1	151.0
Appalachian:														
District 1	96	44.1	3.0	25.1	7.9	5,657	801	4,475	488	97	41.8	2.6	21.4	6.2
District 2	110	55.3	4.9	21.7	10.4	2,945	499	1,736	324	96	52.9	5.6	16.8	6.2
Ind., Ill., Ky.	1,444	782.3	68.1	308.8	131.8	32,431	7,206	30,119	5,975	1,441	775.5	61.5	298.0	135.9
Minn., Wis., Dak.	116	52.9	6.7	23.1	20.3	6,201	1,632	8,231	639	104	49.6	4.6	27.0	11.0
Okla., Kan., Mo.	738	404.7	5.9	189.7	21.7	16,928	1,818	14,245	959	737	412.0	8.8	189.4	22.1
Inland Texas	278	209.0	10.6	46.7	19.7	6,660	621	1,563	2,557	276	217.7	7.1	47.9	21.0
Texas Gulf Coast	1,737	933.6	118.1	408.1	112.9	25,667	3,877	18,091	6,057	1,795	911.7	86.9	420.1	138.8
La. Gulf Coast	681	332.1	87.6	132.7	48.4	10,317	1,986	6,798	1,549	706	377.7	61.1	147.8	49.2
N. La. and Ark.	107	80.0	8.1	19.7	6.0	5,325	1,115	2,507	128	73	33.5	3.1	13.9	5.4
Rocky Mountain:														
New Mexico	16	8.9	0.4	3.0	1.7	655	53	178	30	23	12.1	0.2	4.4	2.1
Other R'ky Mt.	293	143.3	3.9	60.1	33.3	5,052	391	3,074	1,099	305	145.9	3.3	61.7	32.3
West Coast	1,194	573.8	35.8	169.4	304.3	26,181	1,385	14,351	17,271	1,160	521.8	1.2	175.7	271.5
Sept. 30, 1960	7,949	4,145.4	380.4	1,797.6	881.1	187,417	35,151	168,625	50,325	7,878	4,072.2	276.8	1,745.2	852.7
Sept. 23, 1960	7,963	4,082.1	312.7	1,803.4	912.6	186,906	34,896	165,447	48,344	.....	.....	.....	.....	.....
Oct. 2, 1959	7,618	4,077.7	300.0	1,805.0	832.1	175,857	32,231	174,169	59,524	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

Crude-Oil Prices

GRAVITY SCHEDULE

	Signal Hill, Calif.	Okla-homa	West Tex. (sour)	West Tex. (Inter.)	No.* Texas	Texas Refugio Light	Bayou Sale (La.)	Denver Jules-burg	Wyo. (sour)
14-14.9	$1.86	....	....	....	....	....	....	....	....
15-15.9	1.93	....	....	....	....	....	....	....	$1.81
16-16.9	2.00	....	....	....	....	....	....	....	1.86
17-17.9	2.06	....	....	....	....	....	....	....	1.91
18-18.9	2.13	....	....	....	....	....	....	....	1.96
19-19.9	2.20	....	....	....	....	....	....	....	2.01
20-20.9	2.27	$2.49	$2.35	$2.61	$2.29	$2.95	$2.90	$2.58	2.06
21-21.9	2.33	2.52	2.38	2.63	2.33	2.97	2.92	2.60	2.11
22-22.9	2.40	2.55	2.41	2.65	2.37	2.99	2.94	2.62	2.16
23-23.9	2.46	2.58	2.44	2.67	2.41	3.01	2.96	2.64	2.21
24-24.9	2.53	2.61	2.47	2.69	2.45	3.03	2.98	2.66	2.26
25-25.9	2.60	2.64	2.50	2.71	2.49	3.05	3.00	2.68	2.31
26-26.9	2.67	2.67	2.53	2.73	2.53	3.07	3.02	2.70	2.36
27-27.9	2.74	2.70	2.56	2.75	2.57	3.09	3.04	2.72	2.49
28-28.9	2.81	2.73	2.59	2.77	2.61	3.11	3.06	2.74	2.54
29-29.9	2.87	2.76	2.62	2.79	2.65	3.13	3.08	2.76	2.59
30-30.9	2.93	2.79	2.65	2.81	2.69	3.15	3.10	2.78	2.63
31-31.9	3.00	2.82	2.68	2.83	2.73	3.17	3.12	2.80	2.67
32-32.9	3.06	2.85	2.71	2.85	2.77	3.19	3.14	2.82	2.71
33-33.9	3.12	2.88	2.74	2.87	2.81	3.21	3.16	2.84	2.75
34-34.9	3.17	2.91	2.77	2.89	2.85	3.23	3.18	2.86	2.79
35-35.9	3.22	2.94	2.80	2.91	2.89	3.25	3.20	2.88	2.83
36-36.9	3.27	2.97	2.83	2.93	2.93	3.27	3.22	2.90	2.87
37-37.9	3.31	2.99	2.86	2.95	2.95	3.29	3.24	2.92	2.89
38-38.9	....	3.01	2.89	2.97	2.97	3.31	3.26	2.94	2.91
39-39.9	....	3.03	2.92	2.99	2.99	3.33	3.28	2.96	2.93
40-44.9	....	3.05	2.95	3.01	3.01	3.35	3.30	2.98	2.95

*Cooke, Grayson, Montague.

Flat Prices

Louisiana:	
Sweet Lake	$3.00
Texas:	
East Texas	3.05-3.25
Conroe	3.23-3.53
Van	3.08
Pennsylvania Grade:	
Bradford	$4.75-4.80
Middle District	4.52
Southwest Pennsylvania	4.25
West Virginia	4.17
Buckeye Grade	4.08
Illinois Basin	**3.00-3.05**

Foreign

Middle East, Persian Gulf: (cargoes f.o.b. lifting port)	
Arabian, 34.0°-34.9°, Ras Tanura	$1.80
Iranian, 34.0°-34.9°, Bandar Mashur	1.78
Iranian, 34.0°-34.9°, Abadan	1.73
Iraq, 35.0°-35.9°, Fao	1.72
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.59
Qata, 41.0°-41.9°, Umm Said	1.95
Middle East, E. Mediterranean:	
Arabian, 34.0°-34.9°, Sidon	$2.17
Iraq, Mosul-Kirkuk, 35.0°-35.9°, Tripoli	2.19
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 36°	2.42
Canada:	
Leduc-Woodbend	$2.53
Redwater (Alta.)	2.42
Smiley (Sask.)	2.18
Pembina	2.38
Venezuela:	
Cumbarebo, 47°-47.9°, Tucupido	3.34
San Joaquin, 40°-40.9°, Puerto La Cruz	3.08
Oficina, 35°-35.9°, Puerto La Cruz	2.80
Tia Juana medium, 26°-26.9°, Amuay*	2.30
Quiriquire, 16.0°-16.4°, Caripito	2.10
Lagunillas heavy, flat, Las Piedras*	2.10
Bachaquero, flat, 15°-16°, Las Piedras*	1.88

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Tanker Rates (Long Ton)

(Latest reported spot fixtures)

★ Gulf-NY, clean (ATRS—5%)	$2.71
★ Carib.-NY, dirty (ATRS—50%)	1.43
★ PG-Italy, dirty (Scale—40%) (27s. 8d.)	3.87
PG-Japan, dirty (USMC—60%)	4.08

★ Denotes change from previous week.

Refined-Product Prices

Following quotations are realistic spot prices for refined products moving interstate on Wednesday each week. They may differ from refiners' posted prices and should not be considered as postings.

Light-product prices are in cents per gallon. Residual and crude prices are dollars per barrel. Crude prices are at the well unless otherwise listed.

Gasoline*

Mid-Continent (Group 3):	
Regular (91 octane)	$12.25-12.50
Premium (99 octane)	15.00-15.25
Natural gasoline (26-70)	4.5
Breckenridge	4.0
Gulf Coast (cargoes for coastwise or export movements):	
Regular (90 octane)	11.00
Regular (92 octane)	11.25
Premium (98 octane)	12.25
California (rack) Los Angeles:	
Regular (88 octane)	11.65-12.15
Premium (94 octane)	12.65-13.15
Premium (100 octane)	14.00-14.65
Caribbean area (cargoes):	
Regular (87 octane)	10.125-10.25
Premium (97 octane)	11.75

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

Kerosine and Distillate

Mid-Continent (Group 3):	
Kerosine 42-44	10.125-10.375
Diesel oil (58 d.i. and above)	9.75-10.00
Distillate No. 1	9.75-10.00
Distillate No. 2	8.75- 9.00
Gulf Coast (cargoes):	
Kerosine 41-43	9.00- 9.25
Distillate No. 2	8.25
New York Harbor (barges):	
Kerosine 41-43	10.45
Distillate No. 2	9.45
Diesel fuel, 48-52 d.i.	9.65
Caribbean area (cargoes):	
Distillate No. 2	8.125

Residual Fuel (Bbl.)

Mid-Continent (Group 3):	
Residual fuel (max. 1% S)	$1.90
Gulf Coast (cargoes):	
Bunker C fuel	2.30
New York Harbor (barges):	
Bunker C fuel	2.52
Caribbean (cargoes):	
Bunker C	2.10
California (rack):	
Bunker C fuel, Los Angeles	2.25

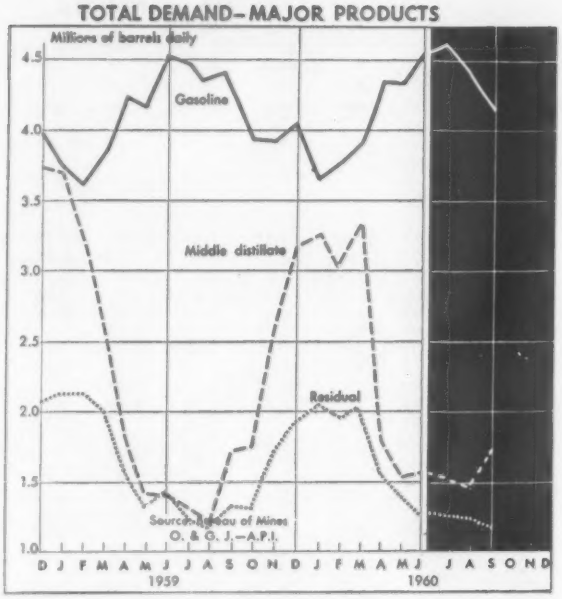
SELECTED MONTHLY DATA

SUPPLY AND DEMAND—MAJOR PRODUCTS
(Thousands of barrels daily)

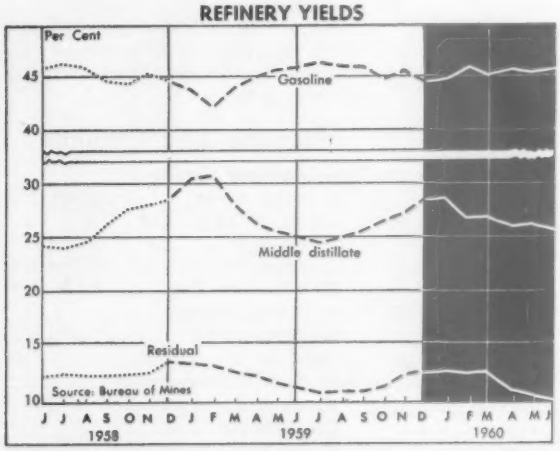
	Total demand	Refinery production	Stocks end of period†
GASOLINE			
September 1960*	4,325	4,175	187,500
August 1960*	4,430	4,215	189,000
July 1960	4,418	4,243	196,021
October 1959	3,953	3,931	174,277
September 1959	4,401	4,111	174,128
KEROSINE			
September 1960*	315	365	35,200
August 1960*	275	380	33,700
July 1960	261	360	30,499
October 1959	261	287	32,395
September 1959	267	277	31,562
DISTILLATE			
September 1960*	1,310	1,835	169,000
August 1960*	1,200	1,855	152,400
July 1960	1,156	1,831	131,044
October 1959	1,515	1,736	181,840
September 1959	1,456	1,745	174,148
RESIDUAL			
September 1960*	1,245	875	50,400
August 1960*	1,250	855	47,000
July 1960	1,216	847	43,848
October 1959	1,315	869	59,506
September 1959	1,325	853	59,429

*Preliminary. †Thousands of barrels.

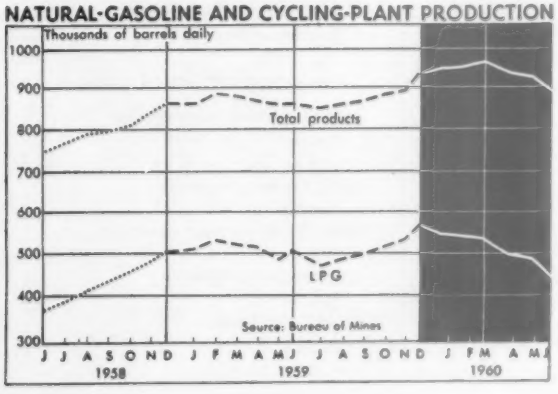
TOTAL DEMAND–MAJOR PRODUCTS



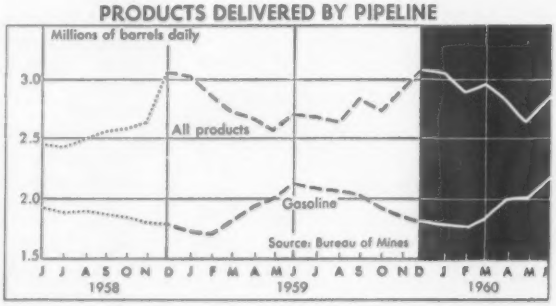
REFINERY YIELDS



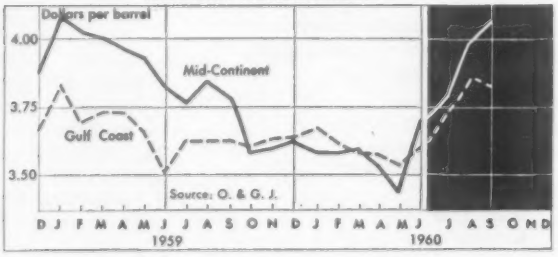
NATURAL-GASOLINE AND CYCLING-PLANT PRODUCTION



PRODUCTS DELIVERED BY PIPELINE



REFINERY REALIZATION



REFINERY REALIZATION

	Sept.*	Aug.*	July	June
Mid-Continent	$4.07	$3.99	$3.84	$3.70
Gulf Coast	3.83	3.86	3.75	3.63

*Preliminary. Refinery realization is based on yields of major products and average spot prices of regular gasoline, kerosine, No. 2 fuel, and residual as published in The Oil and Gas Journal.

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All above in very clean and good condition. S. M. DAVIS, BOX 1407, E. ST. LOUIS, ILL.

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2,000,000 ft.	2"	3.50# to the ft.
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200,000 ft.	8 5/6"	28#
400,000 ft.	10¾"	35#
75,000 ft.	12¾"	40#
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All No. 1 Grade Plain end and cleaned.
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8' x 75' 20 Tray 25#
7½' x 56' 20 Tray 33#
3' x 58' 30 Tray 154#
3' x 47' 20 Tray 120#
18" x 32' 15 Tray 130#
2' x 30' packed 50#
4' x 36' packed 210#
10' x 55' 60#
8' x 43' 60#
6' x 42' 200#
6' x 20' 40#
12' x 43' 25#

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Hot Oil: 1"-6"; 50-400 gpm 100-3,000 ft. hd.
Boiler Feed: 190 gpm 1,500' hd.
Cooling Tower: 7,000 gpm 120' hd.
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Box M-124, The Oil and Gas Journal
Tulsa, Oklahoma

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BOX L-996
THE OIL AND GAS JOURNAL
TULSA, OKLAHOMA

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AN INDIVIDUAL desires to buy 75 to 100 barrels per day of good settled production. Will pay the highest price, all cash. Please write to Milton Gessner, Laconia Building, Wheeling, W. Va.

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BUSINESS OPPORTUNITIES

INDIVIDUALS OR GROUP to finance Engineering, Manufacturing, Sales and Service Organization for Oilfield Production Equipment. Cash and/or manufacturing equipment required. Box M-127, The Oil and Gas Journal, Tulsa, Oklahoma.

FINANCIAL—Investment Banking Houses and Underwriters reached. Confidential. You can send the details of your proposition direct or thru your attorney to Consultant 817—51st Street, Brooklyn, N. Y.

I OWN AND am going to sell Geological Library, over 1,300 surface maps covering Oklahoma. Opportunities unlimited as basis for exploration by and development of a new company. Box M-109, The Oil and Gas Journal, Tulsa, Oklahoma.

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RELIABLE OIL COMPANY would like to make deal to develop shallow locations in Southwest. Have equipment for 15 or more wells. Can finance all or part with reasonable pay-out. Box M-120, The Oil and Gas Journal, Tulsa, Oklahoma.

EASTERN KANSAS 155 acres four proven locations Bartlesville Sand Production 1,200 ft. deep. Offsetting large flood. 8/16ths for sale $400.00 per 1/16th to drill No. 1. Box M-118, The Oil and Gas Journal, Tulsa, Oklahoma.

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in California, 15 lots for sale, including mineral rights. $200 each. M. G. Beall, 9412 Yolanda, Northridge, Calif. DI 9-3223.

AMENDED U. S. Mineral Leasing Act now effective. No more 5 year oil-gas leases on U. S. Lands. Now 10 year term. Rents 50 cents acre every year. Free information. John L. Donahue, 430 16th St., Denver 2, Colo.

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FIELD RECORDS WANTED

WANTED: GEOLOGICAL file on North Central Oklahoma. E-logs, sample logs, scout tickets. Contact: McClung, c/o W. H. Pine, Okmulgee, Oklahoma.

BUSINESS SERVICE

DELAWARE CORPORATIONS formed and serviced. American Guaranty & Trust Company, P. O. Box 487, Wilmington, Delaware.

Statement of the Ownership, Management, Etc., of THE OIL AND GAS JOURNAL, October 10, 1960

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The average number of copies of each issue of this publication sold or distributed through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was 43,909.

S. H. ROURKE,
Business Manager.

Sworn to and subscribed before me this 30th day of September 1960.

ROBERT D. FUNK,
Notary Public.

My commission expires April 19, 1963.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Sacramento, California. Notice is hereby given that 570 acres of land in ten parcels within the known geologic structures of certain fields in Kern County, California, will be offered for competitive oil and gas leasing through sealed bids to the qualified bidder of the highest cash amount per acre at 10:30 A. M., PST, October 20, 1960, when bids will be opened. Full details of the lease offering, how and where to submit bids, may be obtained from the Manager of the Land Office at Sacramento, California. Walter E. Beck, Manager.

Oil-soluble corrosion inhibitor

. . . for ferrous surfaces is detailed in a technical bulletin now available. The product—Atpet 200—is a nonionic inhibitor that is suggested for uses as an oil additive for rust prevention of diesel and gasoline engines, turbines, tools, and component parts during processing or assembly. Source: **Atlas Powder Co., Wilmington 99, Del.**

Cooling-tower

. . . bulletin entitled "How to Extend Cooling-Tower Life," has just been made obtainable. The two-page data sheet discusses how the deterioration of wood by chemical, biological, and physical factors shortens the life of cooling towers. Source: **Betz Laboratories, Inc., Gillingham and Worth Sts., Philadelphia 24.**

Pressure reducing and relief valve

. . . designed for initial pressures of 4,000 psi. with water, air, oil, or gas, is described in a new two-page catalog sheet. The ⅛ and ¼-in. 3850 Type-F valve is a single-seated, spring-loaded, diaphragm-actuated type with adjustable pressure ranges of 0 to 1,000, 0 to 2,000, and 0 to 3,500 psi. It is said to be capable of controlling pressures within as little as 2 to 3 psi. over the entire adjustable range. The literature includes features, operations, applications, descriptions, installation, and ordering data, along with a photo, drawings, and capacity charts. Source: **Atlas Valve Co., 280 South St., Newark 5, N. J.**

Wire, rod, and strip handbook

. . . describes new 17-in.-wide Sendzimir strip mill, annealing and slitting facilities, and limits. Forty-four-page Price and Technical Data Schedule 14 features enlarged charts which have basic prices and all extras listed on one page. The handbook offers data on chemical, physical, and mechanical properties of several alloys and includes ASME and ASTM specifications for the metals. A special section tells how to effect all possible economics in metal purchasing. Source: **Techalloy Co., Inc., Rahns, Pa.**

Mercury-vapor floodlights

. . . which are weatherproof, are described in new Catalog MV600 just issued. It offers illustrations and specifications on single units and clusters for pole-top, midpole, wall, or surface mounting—with or without integrally mounted transformers. Source: **Stonco Electric Products Co., 333 Monroe Ave., Kenilworth, N. J.**

Orifice-fitting

. . . catalog presents the Senior fitting, a double-chamber product which allows changing of orifice plates without line shutdown or bypass. Catalog Section A includes parts illustrations which show a new equalizer valve and stuffing box, along with installation, operation, and maintenance instructions for the fittings. The fittings are available from 2 in. to the largest line size and in ASA pressure ratings of 150 to 2,500 lb. Source: **Daniel Orifice Fitting Co., Box 19097, Houston 24.**

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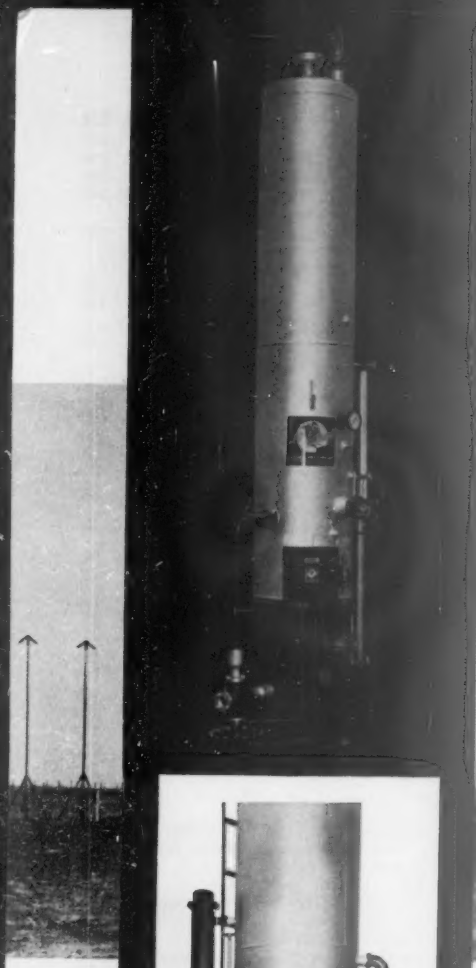

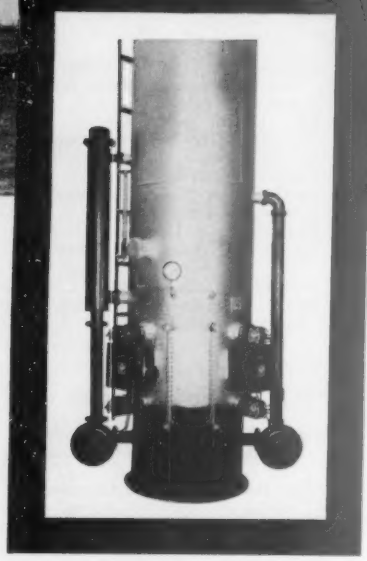

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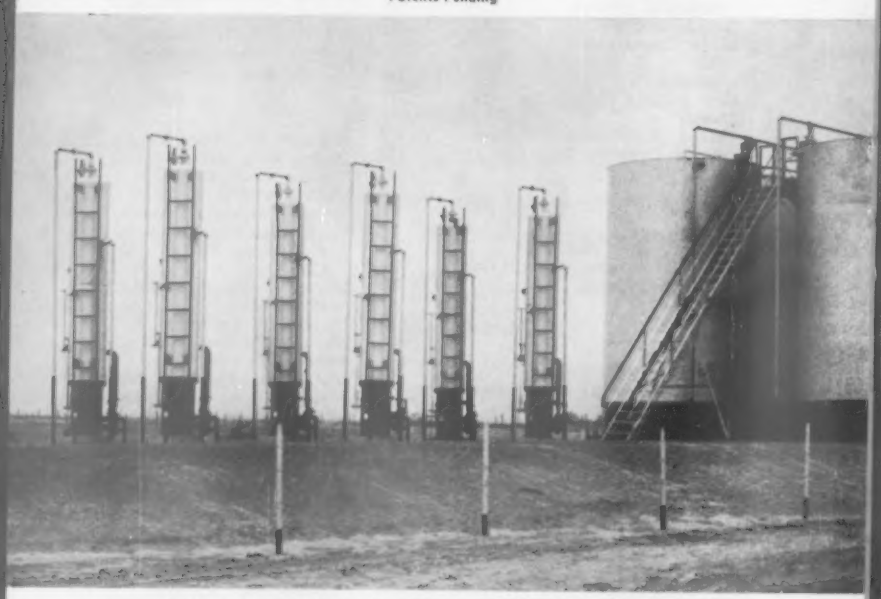

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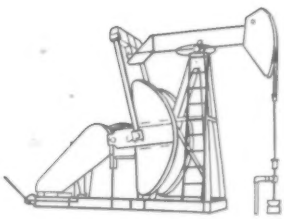

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